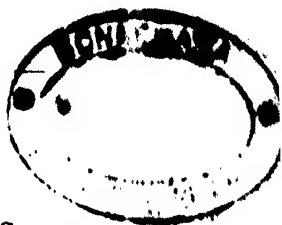




# INDIAN GRASSES.



BY

T. J. SYMONDS, F.L.S.,

MEMBER OF THE ROYAL COLLEGE OF VETERINARY SURGEONS,

VETERINARY SURGEON (1ST CLASS),

ARMY VETERINARY DEPARTMENT.

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TO  
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MEMBER OF THE ROYAL COLLEGE OF VETERINARY SURGEONS,  
INSPECTING VETERINARY SURGEON,  
ARMY VETERINARY DEPARTMENT.

THIS SMALL WORK

*Is Inscribed*

WITH MUCH RESPECT,

BY

THE AUTHOR.





## PREFACE TO THE SECOND EDITION.

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THE success of the First Edition of this small work (which was out of print in less than three months after publication) has imposed upon me, thus early, the agreeable duty of preparing another edition.

The book has been re-arranged and some new matter added. I have also altered the title from the “Grasses of the Indian Peninsula” to that of “Indian Grasses.”

BANGALORE,        }  
*October* 1885.    }



## P R E F A C E

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IN 1882 I commenced a series of articles on the "Grasses of the Madras Presidency" in the QUARTERLY JOURNAL OF VETERINARY SCIENCE IN INDIA AND ARMY ANIMAL MANAGEMENT. These articles I am led to believe proved of much interest to the profession and the horse-owning Indian public, and by them I have been requested to produce the series in book-form.

I have endeavoured to make the subject more generally useful by dealing with the grasses of the Indian Peninsula, but it must not be imagined that my list is complete, there are probably many existing grasses of which I have never heard, but on the whole I think it will be found that the list is fairly comprehensive, and that at least the more common kinds of grasses have been described.

All I have attempted to do is to bring to prominent notice those most useful as forage ; many of the species undescribed are useless for this purpose, and their description is more of botanical than dietetic interest. I have endeavoured to diffuse a certain amount of practical knowledge of fodder-grasses, and have done so as the subject is increasing in importance every day. The illustrations should be found a useful guide in determining the species growing in any place, and the letter-press accompanying each plate will be of use to those who take a scientific interest in the genera.

We have much yet to learn regarding the value of many of the kinds described, and I trust that others may do their share in determining, and placing on record those grasses which are found by practical use to be deleterious to the health of stock.

I have just seen a useful article on up-country grasses addressed by Principal Veterinary Surgeon Oliphant to the Commissary-General of Bengal, it may be consulted on the subject of forage and feeding generally with very great advantage.

We have much to expect from Ensilage, a matter with which I have not dealt. The art of preserving food for the cattle of this country for use during the hot and dry months, is of supreme importance, and I trust that the numerous experiments which have been conducted in many parts of India to prove its value, may lead to its general adoption. In no other country is such a system as Ensilage required more than in India.

I have not hesitated to quote from other observers ; this was necessary to the elucidation of my subject, and I think that these quotations add considerably to the value of the book.

It now only remains for me to acknowledge the assistance I have received from the Editors of the Quarterly Journal of Veterinary Science in India, who have courteously placed their type at my disposal, and who have in this and many other instances rendered me useful and valuable assistance.

T. J. S.

ST. THOMAS' MOUNT, }  
November 1884. }

## PRINCIPAL WORKS REFERRED TO.

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- DUTHIE.....*The Field and Garden Crops  
of the North-West Prov-  
inces.*
- GRIFFITH.....*Itinerary Notes on Plants  
collected in India.*
- LINDLEY.....*Treasury of Botany.*
- LOUDON.....*Encyclopedia of Plants.*
- MELLICOTT AND BLANDFORD...*Geology of India.*
- ROXBURGH.....*Flora Indica.*
- SOWERBY.....*The Grasses of Great Britain.*
- STEUDEL.....*Synopsis Plantarum Gluma-  
cearum.*
- STEWART.....*Punjab Plants.*
- WIGHT.....*Prodromus Floræ Peninsulæ  
Orientalis.*



# INDIAN GRASSES.

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## INTRODUCTION.

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THE supply of forage grass to the mounted troops of India is a question which every year is assuming a more serious aspect. The peculiarity of the Indian mode of supplying horses with this necessary article of diet by means of the grass-cutter system, the probability of this system breaking down under any strain, and the loss of condition which this state of affairs would inevitably entail, renders the grass-supply a question of great importance to all concerned in the welfare of our mounted corps.

Before passing on to consider the grasses we must glance at the physical and geological aspects of the country in which they grow.

*The Madras Presidency* occupies an area of 138,856 square miles, its extreme length from N. E. to S. W. is about 950, its extreme breadth about 450 miles, and it has a population of about 34,962,000 inhabitants. The general aspect of the country is very broken, and it is divided into three divisions, the Eastern and Western Ghauts and the Central Table-land. The Eastern Ghaut is pierced by the three rivers, Godavery, Kistna and Cauvery, but the Western remains unbroken. The Central Table-land lies at an elevation of about 3,000 feet. These physical characteristics have a great and important bearing on its cultivation, for the well-watered eastern district is most productive, the unbroken western the same owing to the heavy rainfall, whilst the table-land is comparatively barren and unproductive. The soils of this presidency were originally formed by the disintegration of rock of the metamorphic and igneous systems; those commonly found are the black cotton and red soil, the latter showing



the presence of salts of iron. Close to Trichinopoly is found the so-called green sand, at Secunderabad large and deep strata of "mhorrum" which is formed of decomposing granite, and around the Madras area the iron stone or laterite.

The Madras Presidency in spite of many advantages is not considered a naturally fertile country, for out of a total area of 88 million acres, 27 millions only are under cultivation, 24 millions are considered as uncultivable, 14 millions as cultivable-waste, and 23 millions are not accounted for. Again, owing to the variability of its soils, the facilities for cultivation are not great, for example, the red soil which in one place may be extremely fertile, in another exhibits every degree of barrenness. Dr. Hunter in his Imperial Gazetteer of India, says, "according to the official principle of classification, the cultivated area is divided into dry, wet and garden lands. Dry lands are those which are solely dependent upon local rainfall, cover about 80 per cent. of the total; wet lands which are those irrigated from river channels or tanks by the natural flow of the water, about 15 per cent.; and garden lands which are irrigated by water artificially raised from wells, &c., about 2 per cent., leaving a balance of 3 per cent. for fallows and pasture lands." It can be seen from the foregoing, that although sufficient and more than sufficient country exists, not only in the presidency but around cantonments for the growth of grass, that everything depends upon the rainfall and the nature of the soil surrounding such cantonment. Practically we know that grasses which grow in Hyderabad will not grow in the south, and again certain grasses flourish and attain a size in the south which is unknown in any other part of India.

*"The Bengal Presidency.*—The immense alluvial plain of the Ganges, Indus and Brahmaputra rivers and their tributaries, the richest and most populous portion of India, covers an area of about 300,000 square miles, and forms approximately one-fourth of the whole surface of British India, exclusive of Burma. The greater part of the provinces known as Assam, Bengal (including Behar), the North-West Provinces, Oudh, the Punjab and Sind, are included in the great plain, which, varying in width from 90

to nearly 300 miles, entirely separates the geological region of Peninsular India from the Himalayas to the north, the Suleman and Kirthar ranges to the west, and the hill regions of Assam, Tipperah and Chittagong to the eastward.

“Plains of Upper Bengal and North-West Provinces.—The great plain of Northern India is the area of an alluvial deposit older than that of the delta, and the greater portion of the area is composed of *Bhángar* land.

“*The Punjab*.—The plains intersected by the five great rivers which combine to form the lower Indus are not, as a rule, simply divided into *Bhángar* and *Khádár*\* like the plains of the North-West Provinces. The fall in the Punjab rivers is much more rapid, and their tendency to desert their channel and take a new course is much greater; in fact, a great portion of the Punjab is evidently composed of recent deposits, and is geologically very much in the condition of Upper Assam. The reason why the Punjab plains are deserts instead of marshes is, that the area over which the water can spread is much greater, while the average rainfall is far less. In the Western Punjab, the barren region, the annual fall of rain only amounts to from 6 to 8 inches, whereas in Assam it is from 66 to over 100.”

“*Bombay Presidency*.—In the neighbourhood of the rivers Tapti and Narbada, which, unlike the other streams draining the Peninsula, flow to the west coast: there is, however, near the sea, a broad and fertile alluvial plain which, in some of its features, resembles the alluvium of the east coast. Commencing to the southward near Dáman, this plain covers the greater portion of the Surat, Broach and Ahmedabad Districts, and continues as far as the Ran, where it joins the area of recent deposits, connected with the Indus valley.

“The alluvium of Eastern Guzerat consists of brown clays, with kankar resting upon sands and sandy clays, with occasional gravels.

\* *Bhángar* is the high land, or flat of older alluvium now at a considerable elevation above the rivers which traverse it; and *Khádár* the low land, the low plain through which each river flows.

“Soils vary with every difference in the under-lying formation, whether it be one of the older rocks, or of the more recent unconsolidated deposits. There are, however, two forms of superficial formations, which have received repeated notice in Indian geological works, and to which a few remarks must be devoted, and one of the two, the regur or black soil, is a very remarkable substance. The red soil also requires notice, because it has been so frequently mentioned in geological treatises.

“Soils might very well be classed into two great sub-divisions:—upland soil, resulting from the decomposition of rock *in situ*, and alluvial soil, due to the surface alteration of river and flood deposits. It would of course be difficult, if not impossible, to draw an exact line between the two, for the alluvial soil, on the margin of every valley, passes by insensible gradations into the upland soil of the hill slopes. The soils of the great Indian river plains belong of course to the alluvial sub-division, whilst the soil found on the plateaus of the Deccan and the undulating country of Southern India is, to a large extent, due to the decomposition of rock *in situ*, although alluvial soil of one kind or another is found in all hollows and occupies large areas in the river valleys. Both “black soil” and “red soil” occur in large quantities in both sub-divisions: but the fine alluvial soil of the Indo-Gangetic plain is very different from either of the forms of surface prevalent in the Peninsula. Where the surface of the Ganges valley has undergone but little change from agriculture, and where it is not impregnated by organic matter, it consists of a very fine, light-coloured argillaceous loam, varying from pale-grey to pale-brown in colour, and becoming very hard when thoroughly dry.

“RED SOIL.—The somewhat ferruginous soils common on the surface of many Indian rocks, and especially of the metamorphic formations, would probably never have attracted much attention but for the contrast they present in appearance to the black soil. They have only been noticed, as a rule, in papers relating to the western and southern portions of the Peninsula,

the black soil country. The commonest form of red soil is a sandy clay, coloured red by iron peroxide, and either derived from decomposition of rock *in situ* or from the same products of decomposition washed to a lower elevation by rain.

“BLACK SOIL, COTTON SOIL, OR REGUR (REGAD).—Regur, in its most characteristic form, is a fine dark soil, which varies greatly in colour, in consistence and in fertility but preserves the constant characters, of being highly argillaceous and somewhat calcareous, of becoming highly adhesive when wetted, and of expanding and contracting to an unusual extent under the respective influences of moisture and dryness. Hence, in the dry season, the surface is seamed with broad and deep cracks, often 5 or 6 inches across and several feet deep. Like all argillaceous soils, regur retains water and consequently requires less irrigation than more sandy ground.

“The *chemical composition* of regur has not received much attention. From the few and partial analysis which have been made, the proportions of iron, lime and magnesia seem to vary, and there appears always to be a considerable quantity of organic matter combined. The black colour appears to be due either to the carbonaceous elements of the soil, or to organic salts of iron, but the tint varies much, being frequently brownish and sometimes grey. The following is the analysis of regur of a superior quality :—

Insoluble	...	...	...	...	62·8
Organic matter	...	...	...	...	9·0
Water	...	...	...	...	8·2
Oxide of iron	...	...	...	...	10·9
Alumina	...	...	...	...	7·6
Carbonate of lime	...	...	...	...	1·5
					<hr/>
					100·0

“Uncultivated black soil plains usually support but few trees, and those, as a rule, of no great size, but the principal product is grass, commonly growing to a height of 3 to 4 feet, but sometimes considerably higher. The growth of grass on the uncul-

tivated plains of India is, however, greatly promoted, and the trees injured or killed by the universal practice of burning the grass annually in the dry season, so that it is probable that, if left to themselves, the plains of black soil would support forests.

“ The fertility of this soil is so great, that some of the black soil plains are said to have produced crops for 2,000 years without manure, without having been left fallow, and without irrigation. On the other hand, some varieties of black soil, occurring near the coast of Southern India, are comparatively infertile.

“ *Distribution.*—Regur is found everywhere on the plains of the Deccan trap country, except in the neighbourhood of the coast. In Southern India, however, tracts of black soil are found scattered throughout the valley of the Kristna, and occupying the lower plains and flats of Coimbatore, Madura, Salem, Tanjore, Ramnad and Tinnevely. There is but little on the Mysore plateau.

“ *LATERITE*, in its normal form, is a porous, argillaceous rock, much impregnated with iron peroxide, which is irregularly distributed throughout the mass, some forms of the rock containing as much as from 25 to 35 per cent. of metallic iron. This iron exists either entirely in a state of hydrated peroxide (limonite), or else partly as hydrated and partly as anhydrous peroxide. The surface of laterite after exposure is usually covered with a brown or blackish brown crust of limonite, but the rock, when freshly broken, is mottled with various tints of brown, red, and yellow, and a considerable portion sometimes consist of white clay. The difference of tint is evidently due to the segregation of the iron in the harder portions, the pale-yellow and white portions of the rock, which contain little or no iron, being very much softer and liable to be washed away on exposure.

“ The exposed surface, whether vertical or horizontal, is characteristic and peculiar. It is extremely irregular, being pitted over with small hollows caused by the washing away of the softer portions.

“ *Infertility.*—The surface of the country composed of the more solid forms of laterite is usually very barren, the trees and

shrubs growing upon it being thinly scattered and of small size. This infertility is perhaps due, to a great extent, to the rock being so porous that all water sinks into it, and sufficient moisture is not retained to support vegetation. The necessary result is, that laterite meadows are usually bare of soil, and frequently almost bare of vegetation. Of course this barrenness is by no means universal; soil sometimes accumulates on laterite caps, and some of the more gravelly or more argillaceous varieties support a moderate amount of vegetation. Still the general effect of the rock is to produce barrenness.

“The Indian Peninsula is so vast, and the variations in climate in different portions so great, that the ingredients of the soil are only one amongst many factors determining the agricultural products of the country. The other principal elements are temperature and rainfall. Very roughly indeed, India might be divided into three agricultural regions.

- I. Extra-tropical India; the wheat region. This consists of the great plains of Northern India in which the rainfall is moderate or small, and the winter temperature comparatively low. The region almost corresponds with that lying north of the January isotherm of 65°. The principal grains are wheat and barley.
- II. The damper portions of tropical India; the rice country. This comprises all Bengal Proper, and all the region north of the Krishna from the Bay of Bengal to the edge of the trap country in the Deccan, together with the coasts and delta lands of Southern India. The principal grain is rice.
- III. The drier parts of tropical India and all the black soil country; the millet region. Besides the whole Deccan trap area, with the exception of the western coast, this • comprises all the black soil tracks of Southern India, and a very large portion of the undulating red soil country. The principal grains are jawári or cholam (*Holcus sorghum*) and bájri or kambú (*Holcus spica*).

“Of course these divisions are not clearly separated from each other. The important point in connexion with the geology is the fact that nowhere in the black soil regions, nor on any of the soils derived from the Deccan traps, except in a small strip of country, with a heavy rainfall, near the western coast, is rice, the staple grain of the country.

“In the Central Provinces, especially in the neighbourhood of Nágpur, the difference between the agriculture of the trap country, with fields of millet, pulses of several kinds, cotton, linseed, &c., produced without irrigation, and the cultivated area of the sandstone and metamorphic rocks, where little is seen growing, except rice and sugar irrigated from large tanks, is as marked as the distinction between the rocks themselves. The wild vegetation of the two formations is as different as the cultivated grains. The whole distinction is of course due to the difference in the soils derived from different rocks.”\*

We have now briefly considered the geological formation of these presidencies, which throws a light upon the agricultural operations, it tells us where good soils may be met with, what improvements are likely to be of any use, and what shape these improvements should take. This course in India is however never adopted excepting on a small scale ; the native of this country is profoundly conservative, he views with distrust and suspicion any innovations as likely to be productive of disaster, what suited his forefathers he is perfectly contented with, and so time goes on, soils become impoverished and take years to recruit their strength, but it matters not to him ; as long as he has got food for the day he is contented to let matters slide, and thus things remain for centuries.

In spite of this apathy, we know of no place in India where forage grass can be grown to such perfection under care and management, as it can at a cantonment in the Madras Presidency. Two crops of hay a year *at least* can be obtained at Bangalore, where great care and attention is paid to its growth, and every means adopted to prevent soils becoming exhausted.

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\* Geology of India. By Messrs. Medicott and Blanford.

## STRUCTURE OF GRASSES.

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THE Grass family is the most important of the vegetable kingdom, and is diffused all over the world. It gives us one of the most important articles of human food, namely, grain, and by constituting the chief portions of meadows and pastures, it feeds our cattle.

All grasses are composed of a stem or *culm*, which is hollow, cylindrical, and jointed at intervals. The leaves which arise from the joints are sheathed, the sheath being generally split down the front, and embracing the stem; the upper part gradually tapers to a point and is very thin, it is separated from the sheath by a scale-like stipular projection called a *ligule*.

The flowers are arranged in terminal spikes, racemes or panicles. Each spikelet is composed of three or more chaff-like concave scales called *glumes*. The first and second are usually empty and have a different shape from that of the others. The succeeding or flowering glumes are known as *paleæ*, which are thinner and have two longitudinal ribs or veins, placed either between the glume and the axis of the spikelet, or opposite the glume at the end of the axis. Sometimes the midrib of the flowering glume is prolonged into a peculiar bristle or hair-like process, which in some grasses is of considerable length, and is called an *awn*. Within the palea or between the flowering glume and the palea is the real flower, composed of *lodicules* which are minute scales, of three stamens, but in tropical countries the number is often increased to six or more, and of a 1-celled, 1-ovuled ovary. The stamens are composed of a lower stalked-like portion bearing an upper thickened grooved head. The stalk is called the *filament*, and the head the *anther*; the latter in all grasses is notched at both ends, and is called *versatile*, because it turns on a pivot.



The pistil occupies the centre of the flower, and arises from the ovary. Two slender processes called *styles* may be noticed extending from the summit of the ovary, and terminating in feather-like extremities, which are termed *stigmas*.

## GRAMINACEÆ.

A natural order of glumiferous monocotyledons belonging to Lindley's glumal alliance of Endogens. Annual or perennial undershrubs, very seldom aborescent. *Rhizome* fibrous, sometimes woody and thickened, or bulbous. *Culms* fistular, cylindric, articulated with annular tumid, seldom contracted knots. *Leaves* narrow, alternate, solitary, sheathing at the joints, the dilated petiole embracing the culm and forming a sheath, the sheath very rarely narrowed at its exit into a flattened or tubular petiole; the blade always undivided, nerves parallel. *Flowers* hermaphrodite, monœcious, polygamous, seldom dicecious, arranged in one or many flowered spikelets and forming a spike, thyrse, raceme, capitule, or panicle, generally green, seldom coloured. *Oalyx* most frequently 2-valved (*glumes*), seldom 1-valved or none. *Perianth* (*corolla*) similar to the glumes, 2-valved, seldom 1-valved. *Valvelets* (*paleæ*) dissimilar, outer one (*inferior*) generally keeled, 1-3 or many nerved, muticous or awned, inner one (*superior*) generally 2-nerved, muticous, rarely awned, sometimes deficient; *Scales* hypogynous, succulent, minute, irregular, 2-3, sometimes none. *Stamens* hypogynous, 1-6, usually 3; anthers versatile. *Ovary* superior, 1-celled (rarely one or more), 1-ovuled. *Styles* 2 or 3, rarely united. *Stigmas* plumose, or hispidulous. *Fruit* a caryopsis, free or adnate to the valvelets. *Pericarp* adnate to the seed, thin, membranaceous, seldom crustaceous. *Embryo* lenticular, lying on one side at the base of the farinaceous albumen.

## SECTION 1. CHLORIDEÆ.

*Spikes* or *racemes* distichous, seldom solitary. *Spikelets* many flowered. *Glumes* 2, persistent on the rachis. *Paleæ* 2, seldom muticous at the apex, generally with one or more bristles.

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 GENUS 1. CYNODON.

*Sex*: *Syst*: TRIANDRIA DIGYNIA.

*Origin*. From *Kuon*, a dog, and *Odous*, a tooth

*General Characters*.—*Inflorescence* a cluster of spreading digitate, umbellate, or racemose linear spikes—*Spikelets* sessile, equidistant in a single row on one side of rachis, compressed laterally, 1-flowered, sometimes an upper rudiment of a second flower—*Glumes* 2, keeled, a little unequal—*Paleæ* 2, compressed, the lower cymbiform—*Styles* 3—*Stigmas* plumose, with simple hairs—*Ovaryopsis* free.

CYNODON DACTYLON. (*Linn.*) PLATE 1. *Panicum Dactylon*, (*Linn*) *Digitaria Stolonifera*, (*Schrad.*) *Cynodon Stellatus*, (*Willd*)

*Botanical Characters*.—*Root* stoloniferous—*Culms* creeping, with their flower-bearing branchlets erect, from 6-12 inches high, smooth—*Leaves* small, downy underneath; those of the creeping barren shoots flat, spreading; those of the *culms* usually involuted—*Spikes* from 3-5, sessile, filiform, secund, from 1-2 inches long—*Rachis* waved—*Flowers* alternate, distichous underneath—*Calyx* much smaller than the corol—*Corol*, the large or exterior *paleæ* cymbiform, with slightly ciliated keel—*Stigmas* villous and purple.

*Note*.—This plant is considered sacred by the Hindoos on account of its great tenacity of life. In India *C. Dactylon* is found everywhere, known in the North as *Dhoob*, and in the South as *Hariali* grass. It is also the *Couch* grass of Australia and America.

Such is the widespread nature of this valuable forage, which

we have selected for our first consideration ; it is the principal fodder plant of this country, unequalled in our opinion by any other for this purpose, possessed of indomitable vitality, growing on almost all soils, under cultivation abundantly productive and assuming a great height, adapting itself to circumstances in hard and dry soils by simply spreading along the ground by means of its running stems, striking out at intervals and taking root, such is the plant which we have now to fully deal with, and determine whether it is (as has been stated) an overrated fodder, explain its methods of cultivation, and the best means to adopt in order to obtain a sufficient supply at any and every time of the year for the use of our mounted troops in India.

Hariali grass is recognized by the characteristics we have named. A representation of the flowering head is given at Fig. I, Plate I, and the herbage and mode of growth is shewn in Fig. II, of the same plate. There are three kinds of Hariali in India, but they are only varieties of the species *Cynodon*, they are known by the name of the black, spreading, and white Hariali. As we just mentioned, it is not all Hariali that assumes the height or mode of growth depicted in Plate I, for everything depends upon the soil or cultivation. In Mysore, for example, this grass in its wild state often reaches in a soft soil several inches in height, whereas on the arid plains of Bengal its height is insignificant, but here, its creeping root produces stems which strike into the soil at intervals, and throw out in all directions fine tufts of grass. (*Vide* Plate Ia.) The creeping stems of the large but uncultivated variety often assume a considerable length, we have seen them four or five feet, growing almost in a straight line, sending down as usual, roots at intervals, and fine young grass a foot in height growing from them. We can see then that in places where the heat is intense and the ground baked, that only the "stunted" variety is produced, but that where the temperature is less, and the hot weather of insignificant duration, the grass naturally assumes a good height, but under cultivation, as we will presently show, may be made to grow to an enormous size. We may add *en passant* that the creeping roots of the genus *Cynodon* and some

other grasses, are said to possess some of the medicinal properties of sarsaparilla.

An important subject in connection with this grass must now engage our attention, we allude to its cultivation, growth, and harvesting, and in this matter, we have been fortunate in obtaining a copy of a report from a general officer of the Madras Presidency, who for twenty years has made agriculture a special study, and confined his attention principally to the production of Hariali. So thoroughly and essentially practical are his remarks, that it is only right, that they should be given greater publicity than the *Mysore Gazette* (in which they were published) can afford. We therefore make no apology for quoting his letter *in extenso*, and would remind our readers that what he states is no theory, but the result of sound practical observation.

“In a long career in India, much part of which has been spent in Mysore, I have been strongly impressed with the little knowledge that prevails, of the undeveloped resources of the country, and of the real obstacle that checks every attempt at progress. No movement is ever likely to emanate from the people, as they are perfectly satisfied with things as they are, and can be stimulated to exertion only by the incentive of inordinate gains, or forced into effort by competition with European enterprise. So long as such a state of things continues, it is morally impossible to look for that steady improvement in the method of agriculture, and in the breed of cattle and horses, which is now so perceptible in England, and which enables the farmer to obtain the greatest possible profit out of the soil. On Government, therefore, falls the duty of taking the initiative in this as in many other things; and its attention should, I conceive, be directed mainly to those measures which are now calculated to benefit not the few, but to such as may eventually affect the whole body of the people. As we reflect on the comparative failure that has hitherto attended the desultory efforts made by them to establish horse, sheep, and cattle farms, we are forced to the conclusion that the country is unprepared for their reception, and that there-

fore we must go further back still to lay down the fundamental principles upon which agricultural advancement should be based.

“ With the above object, let us contrast the relative position of the two countries I have mentioned, England and India. In the former we see a country in which there is a period in the year, viz., winter, during which the soil has rest, and for which the farmer has, in anticipation, to lay in a stock of hay and roots, on which his cattle are supported till the spring weather sets in. And so in India we have a period of exhaustion, viz., the hot weather, in which the soil is so parched from the powerful rays of a tropical sun, that there is nothing left from one corner of the land to the other sufficient to feed anything beyond a goat, with this material difference however, in practice, that the native farmer thinks not of laying in any store for such a season, but allows his ordinary ploughing cattle to wander about the fields, seeking like locusts what they can devour, and reserving only a handful of light straw for the more favored beasts; even the valuable horses of private gentlemen and of Government are supported on dry root-grass scraped from the beds of distant tanks, the only places where a little moisture is left. This too, in the face of the indisputable fact, that with irrigation under an Indian sun abundant crops can be raised at any time of the year, in quantity and quality, as good as even those of England. From these facts the plain deduction is drawn, that in order to improve our cattle, which form a material part of the wealth of a country, our attention must be directed primarily to the provision of an unfailing supply of herbage. Cattle shows, such as that now proposed by Captain Hill, may be all very well in their way, and are certainly deserving of every encouragement; but until we have something to feed our cattle upon, the good derivable from such shows of exotics is confined to a very narrow circle. In all measures of improvement never ought we to lose sight of the common saying, that the size and condition of a beast depends upon what enters its mouth.

“ The supply of herbage in the hot months thus being conceded as the grand desideratum of the country, I shall proceed to show

what can be easily effected in the production of hay, being satisfied that it can be extensively raised in Mysore together with other crops, such as oats, clover, mangold-wurzel, lucerne, and guinea grass.

“ From my love of horses, I was the first to attempt the cultivation of hay at Vellore; but it was not till after experiments extending over three years, that I succeeded in obtaining satisfactory results. To some it may seem a simple enough matter to grow grass, but all digging, manuring, and watering are to little purpose, unless carried out on a totally different system than that which is generally pursued at Bangalore. The radical errors of the system consist in scratching up the surface soil only 5 or 6 inches by a country plough, and applying the manure only to the surface to be washed in by the rains. All must allow, that before the rains come, the best properties of the manure are absorbed by the rays of an Indian sun, and therefore it benefits the roots only to a trifling extent. The growth of the Hariali grass root, which, if given free course, will find a depth of 2 feet, is also checked on reaching stiff soil. Now it is my object in this paper to show, that in reversing this system, lies the secret of success, for all the nourishment the grass requires is at the bottom and not the top. This was my guiding principle in the method I pursued.

“ And, first let me point out that in the Hariali or Dhub-grass, we have an undeniably good and durable production. It is superior to every other herbage in this country for sweetness, and nourishment, and with shade, such as light bushes or straw strewed over it, *it rises like a creeper 5 or 6 feet high,\** and when chopped up it will take root. For its successful culture a deep rich and light soil is now indispensable, and as this is not everywhere to be found, judgment is needed in the selection of the ground to avoid expense: but even in paddy fields it will flourish when the soil is properly prepared with a liberal admixture of tank silt, as was proved in my compound at Vellore.

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\* The italics are mine.—T. J. S.

“In preparing the ground for this purpose, it ought at least to be dug half a yard deep and removed in heaps on either side of any space, say a chain square (66 feet). Cart loads of fresh dung from a bandy-stand or karkhana, or what may be available, should then be spread, 9 inches thick all over the excavated space, and at once covered up by the soil thrown through an ordinary chunam mat sieve; this latter step may seem unnecessary, but has my reader ever noticed that most obnoxious of all weeds the Corra, which cannot be eradicated by any other means than by this trap; for it has long fibres like coir, which spread far and wide, and produce an oily nut useful only for medicinal purposes or for the fattening of pigs, but chokes every other description of grass, a fact any native gardener will tell you. In this manner, by degrees, I prepared my 5 acres of paddy land, having water sufficient from three wells to irrigate the whole throughout the dry season.

“The planting of the grass should be conducted as follows:—The main water channels having been laid out and the ground nicely levelled, a man with a *momti* makes a furrow along a line, closely followed by a woman or boy with a basket of fresh Hariali roots, which are laid flat all along, and the man returning covers it up, and in doing so forms a second furrow, and in this way a large extent can be planted in a day. The whole accomplished, the ground is then lined off into beds, 3 feet broad and 35 long, with a very gentle fall of 6 inches to admit of the water flowing speedily to the end, and to prevent too much absorption, which is injurious as well as wasteful. The marginal banks need be only 2 inches high. Once the grass is well up, irrigation twice in the month suffices. The crop will be ready for the sickle in 30 or 35 days. After it is cut, care should be taken to have it properly dried or it becomes musty in the stalk; and therefore it must be kept on the ground and tossed about for three days.

“The average yield is 2 tons an acre, and that for eight successive crops during the twelve months. In the course of time it will be observed that the Hariali roots become as long and as thick as swamp grass, and once they find their way to the riches

provided below, they guarantee an abundant supply. Eventually however the grass becomes too thick, and it is necessary to lighten it with a country plough; on these occasions a top-dressing should be applied, and in re-adjusting the beds, add a few baskets of soil for the sides; on two or three occasions during excessive rains, myriads of caterpillars appear, and the only course that can be adopted is immediately to cut down the crops, when the insects fall an easy prey to the crows which assemble in great numbers for the feast thus provided, and the succeeding crop is quite free of the pest. My best crops, I found, were produced in the hottest weather, the hay being sweeter and more nourishing from the combined effects of sun and irrigation, than that of grass produced solely from monsoon effects.

“ If the several points above laid down are attended to, the yield from 5 acres will be found not less than 50 tons in the year. To show that this is not overstated, I may mention that on one occasion I measured the crop of grass obtained from a given space, and found it reached  $2\frac{1}{2}$  tons an acre. Not only was I always able to feed 8 or 9 horses and sheep with my hay, but to meet the demand of the racing studs and livery stables at Madras, I was further able during the last Burmese war, at a time when there was not a blade of grass in the country, to supply all the hay needed for the Horse Artillery sent to Rangoon, and had the satisfaction of knowing from the Commissary-General that the fine condition in which they landed was attributed to the quality of hay they fed on.

“ Now, if all this can be achieved by an officer working on a small scale in his own compound, what may not be expected from those who could secure town sewage or all the manure from horse lines, bandy-stands, or public karkhanas, and work the system on a large scale? The manure, instead of being collected to form bratties, would then be collected in deep pits well packed, so that layers of soil 2 or 3 inches in depth may be placed over every 2 feet, while a few baskets of lime sprinkled over the surface will add materially to its value; (for every Chemist is aware that lime is a constituent of grass as well as of milk). This



course is the more necessary in the case of horse-dung, which, if exposed, soon parts with its volatile constituents.

“To many interested in this subject the question may devolve simply into one of expense. Will it pay? On this point I may state, that the original cost of this style of farming is heavy where the soil is indifferent; the cost of labor also must vary greatly with the locality. In ordinary good soil little outlay is required save the cost of digging and manuring, but in my case I had to form my soil. The establishment that I found to be needed for watering, bringing in slit and dung, was 3 carts and 10 gardeners, and when the crop was ready for the sickle, 60 women were employed for two days. As may be supposed, once the field is formed, the permanent charges reduced, being limited to 4 men for merely watering, and hired labor once a month sufficient to cut, dry, and stack. With these data any one can work out his own calculations, allowing also for the cost of digging wells and enclosing the ground. I may however add for their satisfaction that it proved to me a most paying concern, and as prices have risen since, it ought now to be far more so. The price now paid by the Commissariat at Bangalore for a very inferior quality of hay is Rs. 50 per ton.

“In my practice I have always studied quantity and quality, I grew only the best grass, and whenever any foreign grasses appeared on my grounds the seeds were immediately removed and the parent root was taken out after the crop was cut; leaving nothing but the real good Hariali. In India the vast majority of people have an idea that everything should grow without considerable outlay or trouble, but look to the expense a farmer now goes to at Home, and thinks nothing of it; and on the other hand, contrast his profits with that of cultivators in this country. It is simply the difference between doing a thing badly and doing a thing well.

“Again, some may feel sceptical as to the extension of such an elaborate process throughout the country; and may naturally put the question, should one succeed in raising hay to the extent expected will the Natives buy? Now I need scarcely remark

that the foundation laid being sound, we may confidently expect that the superstructure will be lasting. Of course every thing must have a beginning, and it may take time before the large body of natives can appreciate fully the advantage of feeding their cattle better, but I know of ryots who are rich in flocks and herds and they may be tempted to try the system for the benefit first of their own cattle. Even in Bangalore we find that dry lands will yield, during the monsoons, two fair crops of hay, and the Commissariat is prepared to pay a remunerative price for all they can procure.

“ Those ryots who have the advantage of a good lay of land, such as below the Hosakote tank and the irrigation channels of Mysore and Hassan, have it in their power to grow enough hay for feeding the cattle of all the villages around. In many parts of the country there is well-cultivation already, and in fact in most districts, there are few villages which do not present similar advantages to be availed of. I have myself noticed fine lands under tanks which are now lying fallow from want of sufficient water, which, after wells are dug, could be well utilized in this way. Were Government also to adapt my system of culture, it would find that instead of 200 Kawals or pasture lands being needed for their Amrut Mahal cattle, one-fourth of the number would suffice.

“ As a further proof that natives are not behind hand to progress when its advantages are brought home to their doors, I may mention that my Maistri, Subraya Moodili, has enriched himself alongside the railroad at the Vellore station, where he may be seen any day meeting the requirements of his constituents, and I know he would be thankful to find a more ready market for all the hay he could produce.

“ To start, however, any novelty among a people like those we have to deal with, Government must be prepared to lend every possible aid ; not only must it be careful to allow a man to enjoy the just reward of his own labor without any extra taxation, but it should take the initiative by starting farms at convenient localities, and fostering the experiment by exempting land thus

cultivated from taxation for the first few years, and by offering prizes to those who cultivate their lands best, together with purchasing all the hay that can possibly be required for the Commissariat Department.

“The great desideratum in this country thus being supplied by an improved system of cultivating hay, there is practically no limit to improvement in stock. I have no doubt that the cultivator of the country will the more readily join in the movement when a better price rules the market for well-fed cattle and sheep; should any one wish to experiment in this line, let them send only for a ton of Vellore hay, have 50 wethers in a shed 9 feet broad with a well-filled rack of hay all along, with clean water, gram, and a little salt, on no account let them graze about, and in two or three months, I guarantee, that they will be able to put a delicacy on the table that may be sought for in vain in this benighted Presidency.”\*

Such is the valuable account of this grass with its method of cultivation, as given by General Ottley; it must be conceded that his case is a very strong one, and that he has proved his point. It is deeply to be regretted that Government will not give his excellent system a trial, and so be in a position to be perfectly independent of the public market, whose supply could not possibly bear the least strain. In cantonments where General Ottley's method is practicable, the object should be not only to grow enough for the year's consumption of the mounted troops there quartered, but to have a quantity stacked, so that in the event of an emergency, it could be forwarded in trusses wherever required, compare such a system to the one extant, imagine the benefits this would have been during the late Afghan War, or even the Egyptian Expedition; with management and forethought there is no reason why the whole of the mounted corps on field service should not have been supplied with hay equal to the best upland meadow hay of England!

We believe that it is contemplated to establish grass lands near

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\* *Mysore Gazette*, Major General Ottley.

each cantonment; such lands need management, and the space required large, in order to meet the demands upon it. If these lands were cultivated in the manner described all the year round, half the amount would be required, the yield six or eight times as great, and the expenses after being once started, no more.

Let us briefly calculate the amount of land required according to General Ottley's principle. The largest number of mounted troops in any single station in India is about 1,100; allowing each horse 12lbs. of hay per diem this would amount, in round numbers, leaving a margin for cases where extra diet might be ordered, of 2,000 tons annually. To meet this demand it would only be necessary to place under cultivation 200 acres of land. Now, should ruck lands be established, 200 acres would never meet the demand, so that the extra item of cost in preparing the ground would eventually be compensated for by the less land to look after, and the infinitely superior article grown.

This matter is worthy of the serious consideration of Government; is it better to forage our horses on excellent hay, of known quantity and quality all the year round, or to depend upon the grass-cutter system, which, on active service breaks down, in the hot weather is quite unequal to its task, and during the other part of the year is probably the means of introducing Anthrax into our stables, through the roots and rubbish which constitute the chief grass-supply of India?

We urge the necessity of giving this system a trial; our Walers are valuable horses, and it would be to the interest of the public, to establish a system, whose superior merits are too self-evident to need comment, and abolish one whose chief characteristics are to break down under strain, unequal to its work in the hot season, and a fruitful source of disease among the horses of the Indian Army.

General Ottley mentions in his report a grass called Corra, which is very fond of growing in company with Hariali, and when allowed to do so, is most difficult to eradicate. We have figured this so-called grass, known botanically as *Cyperus Rotundus*; its deep roots and bulbs are well shewn in the drawing,

striking down into the soil and continuing uninterruptedly for a considerable distance. See Plate 66.

While dealing with *Hariali*, we must not forget to mention that it is occasionally attacked with the smut fungus, *Ustilago Segetum*. In our own experience we have found this to be very common in the Punjab and Mysore. In Plate 1b, is figured a flowering head effected with this disease, its withered, drooping, sickly look, and its soot-like appearance is unmistakeable; Fig. 2 of the same plate shews one of these sooty bodies enlarged; Fig. 3 is a microscopical appearance of the disease.

We purpose considering under the head of *Hariali* grass the important subject of its growth, preservation, and mode of supply. We deal with it now because any grasses we may hereafter have to discuss are of very secondary importance, and many of them totally unfit for preservation. The vexed question of grass-supply cannot well be separated from that of its growth and preservation.

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## THE PRESERVATION OF HAY.

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*Cropping and Harvesting of Hariali Hay.*—Under thrifty cultivation, that is, not being extravagant in the use of materials or labor—*Hariali* grass will yield three crops during the rainy and cold seasons. The best *dry* land will in this manner produce from  $1\frac{3}{4}$  to 2 tons of hay per acre, but the average yield from mixed soils will not usually exceed  $1\frac{1}{2}$  tons. Being richer in food substances, the first cutting—usually taken in July—should be separately stacked for the use of valuable horses. Active growth commences with the early rains, and subsides shortly after the cessation of the N. E. Monsoon. From two, to two and-a-half months are required for the full development of a single crop; harvesting being commenced shortly after the flowers appear.

It is almost needless to repeat what must already be well known, *i.e.*, that the ultimate value of hay is chiefly regulated by

the age it is allowed to attain when cut. Prior to the flowering period, the nutrient matters of the culm and leaves are not fully assimilated, and cured at this stage of growth the grass is said to be "without substance." On the other hand it is equally injurious to defer harvesting until the grain is fully developed, as, the latter absorbs the greater part which is useful, and then falls off during the mechanical operations of curing. The proper time to reap, then, is directly after flowering, or when the grains are small enough to maintain their attachment to the culms. Hari-ali grass supplies the finest quality of indigenous hay, but its value will deteriorate in proportion to the quantity of weeds, or other inferior grasses, which may be mixed with it. Hence the great importance of keeping it pure in cultivation.

*Drying and Stacking.*—Having explained at what stage of growth hay-grass may be profitably reaped, it now remains to be stated that the operation should be carried out during the cool hours of the day. This may appear to be a trifling matter, but it is nevertheless very important that new mown grass should be protected from the absorbing and frizzling influences of intense sunlight. The drying process should always be very gradual, and in dry sunny weather it may be necessary to shake out the hay-cocks at night, or in the mornings and evenings.

In damp, cloudy weather, the reverse condition will be felt, but unless one is unfortunate enough to have commenced operations during a succession of rainy days, the intervals of sunlight will suffice to dry the hay. But strict watchfulness is needed, and sheds, tarpaulins, and temporary protection of the kind, will be in requisition until the process of drying is fully completed.

To prevent heating and facilitate slow drying, the grass should be gathered an hour or so after it is cut into numerous small heaps. These are readily spread out again as favourable opportunities occur, and as the work proceeds the hay-cocks will gradually be made bigger. In cases where rapid curing becomes compulsory, it is useful to apply a few sprinklings of well-water. Well-cured hay will be thoroughly dry, limp, and sweetly fragrant.

The question is sometimes mooted that, a permanent structure, such as a water-proof shed, is indispensable to the safe preservation of hay, but we are not of this opinion. Practical experience teaches, that confined and over-shadowed places are to be avoided as hay-yards. Let the stacks be fully exposed where there are fresh currents of air. In such a site, it is preferable to form hay-ricks of the very largest size. The foundations for the latter must be substantially erected in proportion to the weight and size of rick: if raised from  $2\frac{1}{2}$  to 3 feet, the hay will be both well-drained and well-aired. Although it may appear to be a very simple matter, yet it requires considerable experience to be able to build a hay-rick correctly. The main points to be observed in carrying out the work consists, 1st, in shaking out the hay well and thus making it uniform and compact in the mass, 2nd, in treading it firmly down to render the whole as solid and firm as possible, and thirdly, in having the stack correctly posed and drawn. Long paddy straw forms the best thatch for fodder stacks. If hay is slightly under-dried in the field, it will not suffer from a sunny day's exposure when being stacked, but fully-made hay should not be heedlessly exposed in this way.

*Comparative value of stacked hay.*—Carefully preserved in the above manner, the finest hay will attain its maximum value as a food product in 8—12 months. It is then most valuable for the consumption of all horses. After the fifteenth month, its value deteriorates, and a two-year-old stack requires to be mixed with newer hay. At three years of age it is comparatively useless except for bedding and manure. (*J. Cameron, F.L.S.*)

It is sometimes customary in stacking, to add, to every layer of three feet in depth, a sprinkled handful of pepper, camphor, and salt. This preserves the hay, in a measure, from the attacks of insects, and, it is said, contributes to the nutrient value of the fodder.

It may be of interest to know what can be done with this grass out of Bangalore, and the following is from the Annual Report, 1879, of the Superintendent of Government Farm, Madras:—

\* *Hariali grass* (*Cynodon Dactylon*.)—The Doob grass of Northern India, the Couch grass of Australia and America—is a

valuable fodder plant, possessing great vitality and wide-spreading roots which are capable of propagating the grass from each section of them; it is suited to our long draughts, and is also capable, under high cultivation and irrigation, of producing heavy cuttings, of tough wiry fodder, which however must possess considerable nutritive qualities; on poor soils it is liable to be crushed out by inferior types of plants, but on those of fair quality it is very persistent and difficult to eradicate; the latter point is detrimental to its use as a crop to be taken in a rotation. When highly cultivated it yields heavily under irrigation and is grown for hay near some large stations.

"In 1868, there was a plot of this grass on the farm measuring 3 acres; it yielded fairly without irrigation, and during the year 1870-71 gave five cuttings yielding 8 tons, 13 cwt. of hay; this hay sold for Rupees 360-13-3, whilst the cost of curing it was Rupees 105.

"After this, the plot was kept for pasture, and in 1875 not half of the grass then growing was Hariali, the remainder being chiefly nut-grass, (*Cyperus Bulbosus*) and finger-grass (*Panicum Sanguinale*)."

The following system is recommended for putting down this grass:—

"The land having been well cleaned should receive a dressing of fold-yard manure: when ploughing in the manure, a woman should follow each plough and drop the roots in the open furrow, the succeeding plough covering them up, when its furrow is similarly planted, and the process repeated: a heavy harrowing and rolling complete the work."

Regarding the curing of hay the following remarks with reference to this grass are of value:—

"Hariali like most other meadow grasses should be cut immediately the flower begins to appear; in this state the juices of the grass are more nutritious, and the hay is far superior than when made from the fully-matured plant. Besides, when cut before the seed appears, the plant is more vigorous and produces



another crop much sooner. Hariali hay is generally spoiled in this country by being too much exposed to the sun's rays, it is quite unnecessary to bleach the grass in order to make it into hay. The great object should be to retain the green color of the grass by drying it as quickly as possible. Under ordinary circumstances two days, or at the most three days, should suffice for making the hay.

"Cutting should not commence until the dew is off the grass. The grass should remain on the ground for an hour or so after being cut. It should then be turned and tossed until sunset. It cannot be tossed too much during a hot sun. To preserve the green color and aroma of the hay it is absolutely necessary to keep it moving. At night, if the dews are heavy, it should be put up in small cocks each containing from two to three cwts. These cocks should not be tramped, though it is advisable to beat the outside smooth with the back of a rake in order that, should a shower of rain fall the water may run off without penetrating the mass. A single hay rope should be passed over the cocks to prevent it from being blown to pieces by a gust of wind. Next morning, after the dew is off the ground, the cocks may be opened again, as on the previous day; care being taken that it is constantly kept moving; at the end of the second day, under ordinary circumstances, it will be fit to cart, though if the weather be at all damp or foggy it will be advisable to give it another day's sunning, of course putting it again into cock at night.

"Hay thus rapidly made is rich in saccharine matters and is therefore very liable to heat and ferment; this, to a moderate extent, does no harm; in fact it gives the hay a good flavor; however, care must be taken that it does not go too far and char the hay. If the hay is loose in a room, exposure for an hour or two in the hot sun will put it all right, or a layer or two of dry paddy or cholam straw may be put through the mass. In the stack it is equally easy to prevent too great fermentation. I have found a single line of six inches drain pipes placed at about the middle of the stack from the centre to the outside, a capital arrangement for keeping down the temperature. A thick bamboo,

or a couple of hollow pieces of the stems of palmyrah or cocoanut trees, the one resting on the other so as to form a pipe, will equally effect the purpose; or, in building, two or three layers of dry paddy or cholum straw placed in a stack will prevent it heating to an injurious extent."

In concluding the subject of the preservation of hay, we may here note the chemical changes which occur in the forage during its transformation from grass to hay, and for this information we are indebted to W. R. Robertson, Esq., M.R.A.C., Superintendent, Government Farms, Madras.

"The chemical changes that grass will undergo, in curing as hay, will vary greatly with the state of growth at which the grass is cut, and the variety of grass.

"Grasses in flower usually contain a larger percentage of albuminoids and ash constituents than *fully* matured grass, which on the other hand, contains more carbo-hydrates. If the process of curing is *carefully* carried out, the digestibility of the grass is preserved; but, as generally conducted, the percentage of indigestible matter is largely increased. Fermentation, of course, destroys the saccharine juices of the grasses, converting them into acids."

## GENUS 2. MICHROCHLOA.

*Sex : Syst :* TRIANDRIA DIGYNIA.

Origin. From *Micros*, small, and *Chloa*, grass.

*General Characters.*—*Spike* terminal, and solitary—*Spikelets* 1-flowered, unilateral—*Flower* sessile—*Glumes* 2, acute, oblong, equal, and muticous—*Valves* 2, much smaller than the glumes, hispid externally; *lower one* ovate, sub-mucronate, mucro-membranaceous, 3-nerved; *upper one* carinate—*Stamens* 2-3—*Ovary* glabrous—*Stigmas* plumose, *hairs* simple—*Scales* 2, adnate.

MICHROCHLOA SETACEA. (R. Br.) PLATE 2. *Nardus Indica*, (Linn.) *Rotboellia Setacea*, (Roxb.)

*Botanical Characters.*—*Culms* many erect, filiform, branched, 2-6 inches high—*Leaves* linear, scabrous—*Spikes* bristly, somewhat incurved—*Rachis* excavated on one side—*Flowers* hermaphrodite, imbricated transversely on the excavated side of rachis—*Calyx* 1-flowered, 2-valved—*Valvelets* equal, membranaceous—*Corol* 2-valved, hispid, membranaceous—*Stamens* 3—*Styles* 2.

*Note.*—Found in Southern India, growing on walls, and among old ruins. It is known as *Peacock grass*.

### GENUS 3. LEPTOCHLOA.

*Sex : Syst :* TRIANDRIA DIGYNIA.

*Origin.* From *Leptos*, slender, and *Chloa*, grass.

*General Characters.*—*Spikes* racemose—*Spikelets* sessile, unilateral, 2 or many flowered, distichous—*Glumes* 2, carinate, muticous—*Valves* 2, lower one 3-nerved, carinate, mucronate or awned; *upper one* shorter, 2-keeled—*Awn* straight, not jointed—*Stigmas* penicilliform—*Scales* 2, glabrous—*Caryopsis* oblong.

LEPTOCHLOA CHIENENSIS. (*Linn.*) PLATE 3.

*Botanical Characters.*—*Culms* ramous and creeping near the base, above expanding, from 2-4 feet high—*Leaves* long, slender, and smooth—*Sheaths* hairy—*Panicle* large, oval, composed of filiform, alternate, simple, expanding, secund branches—*Spikelets* alternate, short pedicelled.

*Note.*—Found on the sides of water-courses, and where there is much moisture.

### GENUS 4. CHLORIS.

*Sex : Syst :* POLYGAMIA MONÆCIA.

*Origin.* From *Chloris*, green, alluding to the color of the grass.

*General Characters.*—*Spikes* digitately fascicled, seldom 2 or solitary—*Spikelets* 2 or many flowered, unilateral on a common rachis, alternate, sessile—*Glumes* 2, lower one smaller, upper one frequently mucronate or awned—*Lower florets* 1-3, hermaphrodite; *lower valve* compressed and carinate, emarginate at the apex, bifid or truncated—*Imperfect flowers* 1 or more, pedicelled—*Paleæ* glabrous—*Styles* at their base uniting—*Stigmas* plumose—*Caryopsis* obovate, and free.

CHLORIS BARBATA. (Swartz.) PLATE 4. *Andropogon Barbatum*, (Linn.) *Chloris Caribæa*, (Spring.)

*Botanical Characters.*—*Culms* below creeping, and ramous, joints smooth, 1 foot high—*Leaves* acute, a little hairy above—*Spikes* digitate, from 6-12, sessile, secund, expanding, 1-2 inches long—*Rachis* striated—*Flowers* pedicelled and alternate—*Calyx* 2-flowered, 2-valved, and awnless. The *lower flower* sessile and hermaphrodite, its corol consists of 2 unequal valves, the *outer* ending in a long colored awn; the other *floret* neuter, on a short pedicel of 2-awned valvelets, *awn* and *margin* of valvelets colored.

*Note.*—Common everywhere. An easily recognized grass, its flowering head resembles the crest of a *pea-fowl*, from which it obtains its *Tamil* name. It is generally found growing in company with *C. Dactylon*. Cattle will eat it readily when young, but when once in flower animals refuse to touch it.

## GENUS 5. ELEUSINE.

*Sex : Syst :* TRIANDRIA DIGYNIA.

*Origin.* From *Eleusis*, one of the appellations of Ceres.

*General Characters.*—*Spikes* seldom 1-2, digitately fascicled—*Spikelets* sessile, unilateral, 2 or many flowered—*Flowers* distichous—*Paleæ* 2, muticous, *inferior* 1-keeled, *superior* 2-keeled—*Ovary* glabrous—*Stigmas* plumose—*Scales* 2, glabrous—*Caryopsis* free, membranaceous, transversely rugose.

ELEUSINE CORACANA. (Gert.) PLATE 5. *Cynosurus Coracanus*, (Linn.) *Panicum Gramineum*, (Rumph.)

*Botanical Characters.*—*Culms* erect, from 2-4 feet high, compressed, glabrous—*Leaves* large, glabrous, bifarious—*Sheaths* hispid—*Spikes* 4-6 digitate, incurved, secund, composed of two rows of sessile, 3-6 flowered spikelets—*Rachis* waved—*Corol* *Valves* equal—*Caryopsis* globular, arilled, and rugose.

*Note.*—The most productive of all cultivated grasses. It constitutes the chief article of diet among the poorer class of natives in Mysore, Circars, the Ghauts, and Punjab; it is also occasionally found in the Himalayas at places 7,000 feet high. Along the Coromandel coast it is called *natchnee*. Roxburgh states that he never found it wild. In Mysore it forms a substantive article of food, where it is placed in pits, keeping sound for many years. Another species, the *Eleusine Stricta*, is cultivated to a great extent. It differs from the preceding in having the spikes straight, being of a larger size, and more prolific. The seeds are also heavier, which cause the spike to bend down horizontally. All the millets prefer a light good soil, from which the water readily flows after heavy rains. In a favorable season the farmers reckon on an increase of about a hundred and twenty-fold. The variety known in Telugu as the *Maddi-ruba-sooloo* requires a richer soil than the others; and in good years, when the land is fit for its cultivation can be procured, increases five hundred-fold.—*Drury*.

## SECTION 2. PANICEÆ.

*Spikelets* solitary, two or more, 1-2 flowered. *Inferior flower* incomplete. *Glumes* thinner than the paleæ. *Florets* 2-valved. *Valvelets* coriaceous, and persistent in fruit. *Caryopsis* compressed.

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### GENUS 6. PANICUM.

*Sex: Syst:* TRIANDRIA DIGYNIA.

*Origin.* From *Panicula*, a panicle, or *Panis*, bread.

*General Characters.*—*Spikelets* either in a loose or close and spike-like panicle, or arranged along one side of the simple

branches of a panicle, usually small, 1-flowered, seldom awned—*Outer glumes* generally 3, the first or lowest small, sometimes minute, the next empty, the third empty or with an imperfect, or male flower in its axil—*Flowering glume* concave, of a much firmer texture, hard when in fruit—*Paleæ* like the flowering glume, smaller, more or less 2-nerved. *Steudel* in his “Synopsis Plantarum Glumacearum” describes 850 species under this genus, divided into 18 sections. Many botanists remove the following into separate genera distinct from the true tropical *Panicums*, viz., *Panicum Sanguinale* (*Digitaria*), *Panicum Verticillatum* (*Setaria*), *Panicum Glaucum* (*Setaria*). Their geographical range is extensive, but they are chiefly found in the tropical and sub-tropical regions of the earth, where one or other of the species constitute the principal fodder-grasses. The millets of Southern Europe, Africa, and Asia are included in this vast genus.

PANICUM FLUITANS. (*Retz.*) PLATE 6.

*Botanical Characters.*—*Culms* creeping at the base, above nearly erect, round, smooth, from 2-3 feet, including the part that rests on the ground—*Leaves* long and smooth, mouths of the sheaths bearded and subciliate—*Spike* compound, partial ones alternate, adpressed—*Spikelets* bifarious, elliptic—*Flowers* disposed in two rows on the outside of the spikelets—*Calyx* 1-flowered, the two exterior valves very small—*Caryopsis* oblong and pointed.

*Note.*—Grows abundantly in a moist rich soil, especially along the banks of streams, ditches and edges of paddy fields.

PANICUM INDICUM. (*Linn.*) PLATE 7.

*Botanical Characters.*—*Culm* prostrate, thin, branched—*Sheaths* glabrous—*Leaves* linear, glabrous or scattered above with a few hairs—*Spikes* sub-cylindric, naked—*Calyx* smooth, no involucre.

*Note.*—Found in Mysore and Coromandel principally. Useless for feeding-purposes. Will not make hay, as it has but little undergrowth.

PANICUM CRUS GALLI. (*Linn.*) PLATE 8. *Panicum Crus Corvi*, (*Roem.*) *Echinochloa C. Galli*, et *E. C. Corvi*, (*Roem. et Schult.*) *Oplismenus C. Galli*, (*Beauv.*)

*Botanical Characters.*—*Culms* filiform, creeping at the base, above nearly erect—*Leaves* soft, downy; sheaths hairy—*Spikes* compound, secund, from 1-3 inches long—*Spikelets* from 4-12, alternate, adpressed, secund, about three-fourths of an inch long—*Rachis* common, 2-furrowed, partial, three-sided, downy—*Flowers* paired or single in two rows—*Pedicels* hairy, of unequal length, but both short—*Calyx* striated, downy—*Corol*, the neuter valve is here present—*Caryopsis* oblong, smooth, shining white.

*Note.*—This grass is found on pasture lands, it is a middle-sized, delicate, and rare species. Its principal habitat is Surat and Bengal. Will not make hay, but cattle will eat it.

PANICUM BURMANNI. (Retz.) PLATE 9. *Panicum Hirtellum*, (Burm.) *Orthopogon Burmanni*, (R. Br.) *P. Bromoides*, (Lam.) *P. Album*, (Poir.) *O. Albus*, (Roem. et Schult.) *Echinochloa Hirtella*, (Schult.) *O. Humboldtianus*, (Nees.) *O. Brasillensis*, (Raddi.) *Oplismenus Burmanni*, (Beauv.)

*Botanical Characters.*—*Culms* creeping, branchy, with their extremities erect—*Leaves* sheathing, lanceolate, wavy, hairy—*Spikes* compound, secund, erect—*Spikelets* from 4-8, alternate, secund, adpressed—*Rachis* common and partial, three-sided. *Flowers* generally in pairs; one sessile, the other pedicelled—*Calyx*, the two exterior glumes are hairy, with long awns, the inner shorter and much smoother.

*Note.*—This species is found on cultivated ground, and grows under the shade of trees. Cattle will eat it, and makes fair hay.

PANICUM SPICATUM. (Delile.) PLATE 10. *Holcus Spicatus*, (Linn.) *Gramen Panicum*, (Pluck.) *Alopecurus Typhoides*, (Gmel.) *Pennisetum Typhoideum*, (Pers.) *Penicillaria Spicata*, (Retz.).

*Botanical Characters.*—*Culms* several, (if the soil on which it is grown is good) from the same seed, erect, with roots from the lowermost points, round, smooth, from 3-6 feet high, and as thick as the finger—*Leaves* alternate, sheathing, broad and long; mouths of sheaths bearded—*Spikes* terminal, cylindric, erect, from 6-9 inches in length—*Pedicels* two-flowered, sometimes one, occasionally four—*Flowers* surrounded with hairs, woolly, and hispid,

about the length of the flowers—*Calyx* 2-flowered, hermaphrodite, and the other male, two-valved; outer valve minute, inner nearly as long as the corol, both awnless—*Corol* of the hermaphrodite 2-valved, male 1-valved—*Caryopsis* obovate, smooth, and the color of pearl.

*Note.*—Grown in India everywhere. Largely cultivated in some parts of the Punjab, and in the high and dry tract south of Rawal Pindee, where it constitutes the chief cereal crop, also especially over the higher lands on the coast of Coromandel. Cattle are very fond of the straw, it being however much inferior to Jaur (*Andropogon Sorghum*). The grain is an essential article of food among the natives, but is considered heating for animals, and apt to induce diarrhoea.

PANICUM REPENS (*Linn.*) PLATE II.

*Botanical Characters.*—*Culms* creeping to the extent of from one to two feet, geniculate, smooth, often colored—*Leaves* lanceolate, base cordate, stem-clasping, and ciliate—*Sheaths* shorter than the joints, somewhat hairy—*Spikes* from four to ten, small, short, sessile, secund, equally inserted on the four to six-sided, villous rachis—*Flowers* generally paired, and both unequally pedicelled, with an involucre of long hairs on the outside of the pedicel—*Calyx*, exterior valve minute, and truncate; the inner two equal, five-nerved—*Corol*, with neuter valve.

*Note.*—Common about the commencement of the rains, on cultivated lands, in gardens, etc. It is a pretty cespitose species which cattle are fond of.

PANICUM ANTIPODUM. (*Spr.*) PLATE 12. *Isachne Australis*, (*R. Br.*)

*Botanical Characters.*—*Culms* many, seldom branched, 1-2 feet high—*Leaves* linear-lanceolate and acuminate, 1-4 inches long—*Mouths of sheaths* and *ligule* ciliated—*Panicle* oblong; branches alternate, racemose—*Florets* linear, obovate, or obovate-globular, solitary, pedicelled—*Glumes* hispid, pointed, and 7-nerved.

*Note.*—Found in most parts of India. Horses and cattle are very fond of it.



PANICUM PETEVERII. (*Trin.*) PLATE 13. *P. Remotum*, (*Retz.*)

*Botanical Characters.*—*Culms* branched, creeping at the base, ascending, apex slender—*Leaves* linear-acuminate, and with the sheaths glabrous—*Raceme* decomposed, lax, partial one alternate, thin, secund, scabrous—*Spikelets* twin, distant, oval, puberulous. *Pedicels* longish, naked—*Glumes* unequal, obtuse; lower one twice shorter; neuter floret 2-valved; hermaphrodite one oblong, mucous, transversely lightly waved and wrinkled, striated lengthways, equaling the upper glume.

*Note.*—Found all over the Peninsula. Cattle readily eat it; makes moderately good fodder, but unsuited for hay-making.

PANICUM ERUCÆFORME. (*Siblh.*) PLATE 14.

*Botanical Characters.*—*Culm* procumbent, branching and drooping, jointed at the little swelling nodes, and covered with short hairs, from 1-2 feet high—*Sheaths* smooth, minute, and hairy—*Leaves* linear-lanceolate—*Spikes* with flowers in two rows, rarely two on the same pedicel, oval-oblong in shape—*Glume* inferior, minute; hermaphrodite, obtuse, and 5-nerved.

*Note.*—If you have a good specimen of *Panicum Caucasium* (*Trin.*), you will find there is but little difference between them, except in *P. Erucæforme* the leaves are shorter, and the sheath covered with hairs. Cattle will eat it. There is a fair amount of bottom grass, and makes a coarse hay. As pasture it is moderately good. Found in Southern India.

PANICUM JUMENTORUM. (*Swartz.*) PLATE 15. *Panicum Maximum*, (*Jacquin.*)

*Botanical Characters.*—*Culms* many, spreading, hairy, 3-8 feet in height—*Leaves* linear-acuminate, ciliated, from 1-2 feet long—*Sheaths* glabrous, except at the joints which are soft-hairy—*Panicle* 1-1½ feet long, branched, the superior branches single, 3-4 inches; the inferior ones 2-5 together at the joints, 6-10 inches long—*Calyx*, glume 2-flowered, 3-valved—*Exterior valvelets* minute—*Stamens* 3—*Stigma* long, protruding at the apex of the flower—*Caryopsis* adhering to the corolla.

*Note.*—*Guinea Grass*; a native of Guinea, elsewhere not indigenous; cultivated in tropical Africa, India, and America. *Baron Von Muller* says "This perennial grass attains a height of 8 feet in warm countries. It is highly nutritious and quite adapted for the warmer temperate zone, hardy as far south as Buenos Ayres. A favourite grass for stall fodder. Succeeds even on poor clay soil, and on sea sand."

This grass thrives abundantly in cultivated land, but when left to its own resources it soon deteriorates in yield and quality. It should be used (cut) before the flowers appear, as the latter exhaust the nutritive substances of the stem very quickly.

*The following extract from one of the Saidapet Reports is of great value :—*

"Guinea Grass—Has of all the grasses experimented with, been found to be the best; it is an exotic, but perfectly acclimatized grass, which is most easily propagated by root cuttings. Its culture is very simple, for if planted at the commencement of the rains, it soon strikes root and is then safe and out of danger for the future. If planted in rows it allows of interculture by cattle power by which means the land on which it grows may be easily cleansed, thus it affords an excellent crop for a rotation. It has been found capable of withstanding our longest and severest droughts without the aid of irrigation, and although its energies remain dormant during such a time, the first rain makes it spring up again most rapidly. This power was never more clearly demonstrated than in a field planted in September 1875, measuring about 2 acres, which in May 1877 after the great drought was as brown and as dry as if it were totally devoid of life; the heavy rains which fell during that month however led to its immediate revival, and, before the third day of rain was over, green shoots had appeared all over the field which grew on and produced a good crop of fodder in two months, which weighed green 5,566lbs.; this was followed by another cutting of 4,564lbs. of dry fodder two months after, an amount equal to about 12,000lbs. green. Not one per cent. of the tufts failed to throw out shoots after the rain referred to.

“An idea still prevails that guinea grass must be irrigated, not only at the time planted, but regularly at stated intervals afterwards, that it must be taken up and be replanted on new ground at the end of every two years at the furthest, and that the fodder is not a suitable food for stock, and can only be used in small quantities for such a purpose. It is perfectly true that if guinea grass is planted in the hot season, or during dry weather, when the soil contains scarcely a particle of moisture and the sky is clear and bright, that the plants will fail completely if not planting under such circumstances. In the driest parts of the country there is always a time when the sky is cloudy and the weather showery, and if such opportunities are properly utilized for planting, the roots can be established well without the aid of irrigation. Irrigation, of course, enables more cuttings to be obtained in a year, but it is never necessary for the maintenance of the crop. It is, however, most necessary to manure land well for guinea grass. It is general on the farm to plant this grass (the sets being obtained by dividing into several parts old tussacks from another field) on the ridge on a showery day, care being taken that they are planted uniformly at a distance of 2 feet apart in each direction, thus admitting the use of the plough between the lines of plants and across these lines at right angles; for it is advisable to pass a plough or cultivator occasionally through and across the crop as the absorptive powers of the soil can in this way be kept up. This ploughing or cultivating should be repeated at any rate once after the removal of each cutting.

“Before the end of the second year the plants from frequent cutting will have formed large tussacks; these should be reduced by simple chopping with a spade, hoe, or man-vetti. It has been found best to make two cuts across the tussacks at right angles to each other, thus dividing it into four parts. Of these, three may be removed, and form excellent bedding for cattle stalls, the fourth remaining to perpetuate the crop. In this way there is no necessity to remove the plants to other ground, but care must be exercised to see that the soil is properly manured, as a crop

which yields such large returns necessarily makes large demands on the soil. The fodder can be used for all kinds of stock, at first it seems to disturb the digestive organs of some animals, but this is only temporary; cattle and sheep have been fed on it exclusively for months not only without any ill effects but with the most satisfactory results. A guinea grass field is a capital place in which to graze working cattle during the hot season, while for ewes with young lambs better pasture could scarcely be discovered. It produces an abundant flow of milk in the ewes, without, what is common in such cases, disturbing the health of either mother or lambs, care must, however, be always observed never to graze guinea grass too closely."

PANICUM MILIARE. (*Lam.*) PLATE 16.

*Botanical Characters.*—*Culms* many from the same seed, erect, branchy, round, glabrous, from 2-3 feet high—*Leaves* glabrous—*Panicle* oblong, beautifully bowing with the weight of the grain; branches alternate, ramous, capillary, angular, hispid—*Flowers* oval, paired upon a common pedicel, with unequal partial pedicels—*Calyces*, *glumes* glabrous, striated lengthways with nerves—*Corol* accompanied by a neuter valve—*Caryopsis* striated, glabrous, and brown.

*Note.*—This species is only found in a cultivated state, and is one of the sorts of dry or small grain, which is cultivated on an elevated, light, rich soil. The seed is an article of diet with Hindoos. Cattle are fond of the straw.

This was one of the grasses experimented with at Saidapet, and in the report of that Institution we find the following:—

"A plot of land measuring 744 square yards was sown with 10 pounds of Shamay seed on the 2nd of August. The crop grew rapidly and with great luxuriance; on the 25th of October, when most of the plants were coming into ear, the whole was cut down, and yielded 4,575 pounds of excellent fodder. This was dried and made into hay which, when cured, weighed 1,411 pounds. After the removal of the first cutting the plants again started vigorously, and on the 18th December another cutting

weighing 2,673 pounds was obtained. This when dried, yielded 925 pounds of hay. The total return thus obtained from the plot during the four months that elapsed between the sowing of the crop, and the harvesting of the second cutting was 7,248 pounds of fodder, which gave 2,336 pounds of hay, equal to 47,151 pounds of fodder, or 15,197 pounds of hay per acre."

The cultivations, etc., were as follows :—

This fodder cost about	2 Ploughings.	Manured with	4
Rs. 1-14-11 per ton,	2 Harrowings.	cart-loads of fold-	
a low price.	2 Weedings.	yard manure.	
	7 Waterings.		

PANICUM MILIACEUM. (*Willd.*) PLATE 17.

*Botanical Characters.*—*Culms* numerous from the same seed, erect, ramous, hispid ; from 1-3 feet high—*Leaves* large—*Sheaths* long, which involve most of the culms—*Panicle* oblong ; branches alternate and ramous ; angular, hispid, and capillary—*Calyx*, all the 3 glumes pointed—*Corol* 3-valved, the neuter valve emarginate—*Nectary* 2, triangular—*Caryopsis* oval, glabrous, 5-nerved.

*Note.*—This cereal is cultivated throughout India for its grain, and fodder. The grain is considered most digestible, and nutritious. In the Punjab it is frequently consumed unground. It grows best on an elevated, dry, light, rich soil, and generally sown after the rains.

PANICUM ITALICUM. (*Linn.*) PLATE 18.

*Botanical Characters.*—*Culms* several from one grain of seed, erect, from 3-5 feet high, cylindric, glabrous ; roots issuing from the lower joints—*Leaves*, margins backwardly hispid ; mouths of the sheaths bearded—*Spikes* compound. There is more or less of a third, or neuter valve on the corol.

*Note.*—Small plants have the spike more erect, and uniform, without vacancies between the racemelets.

This plant is considered to be indigenous to the north of Europe ; but it is more than probable that it is originally from India, and has become, in a long course of years, acclimatized in Italy. The seeds from the former country do not fructify when

first cultivated in the colder climate. This, however, furnishes no proof that what has been stated is not the case; since it is a fact well ascertained by experience, that the habits of plants may be gradually changed, and may become accommodated to other climates.

Italian millet is a native of both the Indies, and of Cochin China, but it is frequently cultivated in Italy: hence its trivial name. In Tuscany it is grown for the purpose of feeding poultry, horses, and other domestic animals. The leaves and straw likewise furnish food for cattle.

Heyne says, in one of his journeys in Hindustan, "The millet is now ripe, and affords an excellent provender for our camels, elephants, and bullocks. I had frequently regretted that so much of the ground was occupied by a small-eared pitiful grain, but the vast quantity of straw, about ten feet long and an inch in circumference, makes a fair compensation for the meanness of the ear."

This is one of the plants called dry or small grain, and is cultivated in most parts of India. The seed is an article of diet with natives. Requires a light, elevated, and fairly dry soil. Produces about fifty-fold in a favourable season. The grain by some people is considered rather heating. In the Punjab the leaves of this plant are used as a pot herb. In many places it grows wild, and is collected to be given as fodder to animals.

PANICUM PSILOPODIUM. (*Trin.*) PLATE 19.

*Botanical Characters.*—*Culms* jointed, leaf-bearing with small branches, from 1-2 feet high—*Sheaths* glabrous, ligule short, ciliary—*Leaves* linear-lanceolate, glabrous, paniculate—*Pedicels* equal in length to spike or longer—*Spikes* linear, oval, mucronate, and glabrous—*Flowers* with an inferior glume, 2-5 nerved, hermaphrodite, and mucronate.

*Note.*—A scarce grass, cattle will eat it.

PANICUM BRIZOIDES. (*Jacq.*) PLATE 20.

*Botanical Characters.*—*Culms* near the base resting on the ground, above ascending, compressed, glabrous—*Leaves* bifari-

ous, smooth : mouths of the sheaths bearded—*Spikes* compound—*Spikelets* bifarious, ovate, ventricose—*Glumes* ovate, lower one-third shorter than the flower, upper a little shorter than the flower—*Caryopsis* ovate, glabrous.

*Note.*—It is common in every soil, and situation, even in deep water ; in a rich and moist soil is often 2 to 4 feet high, and again on a dry and barren one, as many inches. It grows in tufts, and various parts of it are often tinged purple.

PANICUM PROSTRATUM. (Lam.) PLATE 21.

*Botanical Characters.*—*Culms* creeping, branched, 1-2 feet, nodes pubescent—*Sheaths* glabrous or ciliated—*Leaves* lanceolate from a cordate base, ciliated at the base, 1-2 inches long—*Racemes* 4-15, crowded, alternate, much longer than the interstices—*Spikelets* twin and solitary, oval, acute, smooth—*Lower glume* a quarter the length of the flowers—*Hermaphrodite floret* cuspidate-mucronate, slightly wrinkled.

*Note.*—All over India. Grows amongst bushes and under the shade of trees, when exposed to the weather the leaves are smooth shining green, and when under trees of a pale colour. Cattle are fond of it.

PANICUM ÆGYPTIACUM. (Retz.) PLATE 22. *Eleusine Ægyptiaca*, (Roeb.) *Dactyloctenium Ægyptiacum*, (Beauv.)

*Botanical Characters.*—*Culms* creeping near the base, 1-2 feet high, ramous, compressed and smooth—*Leaves* fringed with hairs—*Spikes* terminal, 3-5, horizontal, secund ; generally four-fold, cruciate—*Calyx* daggered, from 3-4 flowered—*Caryopsis* oval, somewhat three-sided.

*Note.*—Western coast. Found growing in tufts. This grass is known as famine corn, and during the late famine it was used as food by the native poor. Cattle are fond of it. The seeds are smaller than that of the *E. Coracana*, which is cultivated on the Coromandel coast, as a corn crop, for its large farinaceous seed. It is there called *natchnee*.

PANICUM SANGUINALE. (*Burm.*) PLATE 23.

*Botanical Characters.*—*Culms* sometimes creeping near the base, the rest erect, glabrous, and about a foot and a half high—*Leaves* long, narrow, glabrous in every part—*Panicle* racemed, sub-erect—*Racemes* from four to eight, secund, erect, rachis three-sided—*Flowers* generally in threes, though sometimes in pairs, or in fours, all have pedicels of unequal length—*Calyx*, *glumes* nearly equal, membranaceous, a little hairy—*Corol*, *valves* rigid, smooth.

*Note.*—Found all over India. When green it yields a fair fodder, but is unfit for hay-making as it has no undergrowth.

PANICUM COLONUM (*Linna.*) PLATE 24. *Oplismenus Colonum*, (*Humb. and Kunth.*)

*Botanical Characters.*—*Culms* below resting on the ground, and rooting; above sub-erect, that part is from one to two feet high, branchy, a little compressed, smooth—*Leaves* tending to be bifarious, short, smooth, tapering from the base to a sharp point—*Spikes* compound, secund—*Rachis* both common and partial, three-sided; the two sides from whence the spikelets issue concave—*Flowers* two or three from the same point, generally three, all sessile, or very nearly so; sometimes a few small bristles mixed with them—*Calyx* striated, very downy—*Glumes* scabrous, mucronate, unequal, three-nerved—*Corol*, the neuter valve is here present, but no *stamens*—*Caryopsis* broad, oval, smooth, a little pointed, three-nerved.

*Note.*—This grass grows in rich soil, and is common on cultivated ground. Cattle are very fond of it, yet it is not grown as fodder in India.

PANICUM FRUMENTACEUM. (*Roxb.*) PLATE 25.

*Botanical Characters.*—*Culms* erect, ramous, a little compressed, smooth, from two to four feet high—*Leaves* large, margins hispid—*Panicle* erect, oblong, rigid, composed of numerous secund, condensed, incurved spikes: they entirely surround the common rachis, and sometimes tend to be verticelled—*Rachis* common, five or six-sided, a little hairy; partial three-sided, waved—*Flowers* almost always three from the same point, one



sessile, the second short-pedicelled, and the third a little longer pedicelled—*Calyx*, with all the glumes three-nerved; the two large daggered—*Corol* with a third neuter valve—*Caryopsis* ovate, pointed, smooth.

*Note*.—There are several varieties of it known to the ryots. The seed is wholesome and nourishing, it is an article of diet among them. It yields about fifty-fold in a good soil. Cattle are fond of it

## GENUS 6. SETARIA.

*See: Syst: TRIANDRIA DIGYNIA.*

*Origin*. From *Seta*, a bristle; the *involucrum* being bristly.

*General Characters*.—*Inflorescence* spike-like, more or less branched—*Spikelets* compressed, single, sometimes 2-3—*Involucre* mucronate, two-flowered, the *inferior* one imperfect—*Glumes* 2, awnless; *inferior* one the smallest, three-nerved; *superior* the length of spikelets, many nerved—*Lower palea* of imperfect floret, like *upper* glume; *upper* one frequently wanting—*Palea* of the fertile floret 2, the *outer* the largest, coriaceous, covering the *caryopsis*.

*Palisot de Beauvois* separated *Setaria* from the *Panicum* chiefly on account of the inflorescence being compact, and having bristles at the base of the spikelets. These bristles remain attached to the rachis after the spikelets have fallen. There are about thirty species, and are indigenous to tropical climates, a few of them are cultivated as a substitute for millet.

SETARIA GLAUCA. (*Beauv.*) PLATE 26 *Panicum Glaucum*, (*Linn.*)

*Botanical Characters*.—*Roots* fibrous—*Culms* procumbent, and striking root; erect, ramous, glabrous, a little compressed, from 1-3 feet high—*Leaves* sheathing, nearly bifarious, glabrous; mouths of sheaths hispid—*Spikes* terminal, columnar, 2-6 inches long—*Flowers* solitary, or joined to the rudiments of one or two more, short-pedicelled, numerous—*Involucels* consisting of a

bundle of hairy bristles which arise from the underneath part of pedicel, and rough with ascending teeth—*Calyx* 2-flowered, in which case one is *male* and the other *hermaphrodite*—The *male corol* consists of one membranaceous glume, which is placed between the *inner valve* of the corol, and *inner glume* of the calyx—*Stamens* 3.

*Note.*—This species is generally found on cultivated lands, growing among the different sorts of small dry grain. It is destitute of bottom grass. Affords a moderately good fodder, but unsuited for making hay.

Roxburgh says “there are two or three kinds of this coarse grass, can any of them be *Alopecurus Indicus*? The small red one comes very near to it.”

SETARIA VERTICILLATA. (Beauv.) PLATE 27. *Pennisetum Verticillatum*, (Brown.) *Panicum Verticillatum*, (Linn.)

*Botanical Characters.*—*Culms* decumbent, afterwards erect, 2-3 feet high, glabrous, filiform—*Leaves* sheathing, linear-lanceolate, a little downy; *margins* hispid—*Mouths of sheaths* hispid—*Spikes* columnar, compound, from 2-4 inches long; not always presenting the interrupted, or divided appearance arising from its branched composition, dark-green, or purplish in color—*Racemelets* verticelled, composed of three or four short pedicels, each bearing a few flowers, intermixed with very stiff bristles—*Involucels* armed with short, stiff, recurved points—*Calyx* as in family—*Corol* a third neuter valve, but no stamens to it—*Caryopsis* 3-nerved, and waved across.

*Note.*—Cattle will not eat it, so is considered a troublesome weed wherever found. Common about rubbish heaps all over India. An easy method of distinguishing between *Setaria Glauca* and *Setaria Verticillata*, is as follows:—In the former the minute erect teeth on the spike are only felt when pushed upwards through the fingers, and the latter when the spike is drawn downwards.

## GENUS 7. PASPALUM.

Sex: Syst: TRIANDRIA DIGYNIA.

Origin. From *Paspalos*, one of the Greek names for Millet.

*General Characters*.—*Spikelets* either solitary, digitate, alternate, or loosely paniced racemes; more or less imbricated, sessile, or short-pedicelled, 2-flowered, occasionally leafy—*Lower flower* 1-paleaceous, membranaceous, muticous, and neuter—*Upper flower* 2-paleaceous, and hermaphrodite—*Glume* single—*Paleæ* 2—*Stamens* 3—*Styles* 2—*Stigmas* brush-shaped—*Ovary* glabrous—*Caryopsis* oblong, or obicular.

PASPALUM SCROBICULATUM (Linn.) PLATE 28. *Paspalum* Kora, (Willd.) *Paspalum* Commersonii, (Lam.) *Paspalum* Orbiculare, (Forst.)

*Botanical Characters*.—*Root* fibrous, annual—*Culms* erect, branched, from 1-3 feet long—*Sheaths* glabrous or ciliated—*Leaves* sub-acuminate, glabrous, linear—*Spikes* 2-4, alternate, sessile, erect and secund—*Rachis* broad, membranaceous—*Spikelets* biserial, oval, short-pedicelled—*Glumes* 5-7 nerved, superior one scrobiculate—*Caryopsis* smooth, and brown.

*Note*.—Found everywhere in India. It is the poorest of Millets, and only cultivated by Hindoos living in the most barren parts of the country, as it is an unprofitable crop, and never grown where a better kind will thrive. It is sown during the rains, and the seed it likes best is a dry, light, loose one. When cooked it is said to taste like rice.

## GENUS 8. TRACHYOZUS

Sex: Syst: TRIANDRIA DIGYNIA.

Origin. From *Trachys*, rough, and *Ozos*, a twig.

*General Characters*.—*Racemes* simple, 1-2, approximated, articulated at the joint spikelets, sub-fascicled, sessile—*Lower spikelets* complete—*Glumes* 3-nerved, coriaceous, lanceolate, membranaceous, and dagger-shaped—*Neuter florets* 2-valved,

coriaceous, cuspidate-acuminate, 13-nerved—*Upper one* minute, obtuse, and nerveless—*Hermaphrodite floret* chartaceous, much shorter than the neuter.

TRACHYOZUS MUCRONATA. (Beauv.) PLATE 29. *Trachys Muricata*, (Pers.) *Cenchrus Muricatus*, (Linn.) *Trachystachys Geminata*, (A. Dietr.) *Panicum Squarrosum*, (Retz.) *Panicum Dimidiatum*, (Burm.)

*Botanical Characters*.—*Culms* procumbent, ascending, branched, 10-12 inches long—*Leaves* linear-lanceolate and hispid—*Sheaths* and *knots* of culms downy—*Spikes* 2, terminal, spreading, ascending, and secund—*Rachis* from 4-8, membranaceous—*Spikelets* in bundles from 4-8, sessile—*Calyx*, *exterior* one minute; *second* large and pointed; *inner* not quite so small as the *exterior*, and ciliated.

*Note*.—A native of dry sandy soil, especially near the sea-shore.

## GENUS 9. LAPPAGO.

*Sex*: Syst: TRIANDRIA DIGYNIA.

*Origin*. From *Lappa*, burdock, because of its prickly flowers.

*General Characters*.—*Panicle* cylindric, 2-5 flowered fascicles; *partial axis* very short; *raylets* alternate, approximate—*Spikelets* fascicled in twos or fives, stiff, 2-flowered-hemigamous—*Neuter floret* 1-valved, large, oval, and acute, glochidiate-echinate—*Hermaphrodite floret* chartaceous, lanceolate, acute, and shorter than the neuter; *lower palra* 3-nerved—*Hypogynous scales* 2, truncated, and terminating in a small tooth—*Caryopsis* oblong.

LAPPAGO RACEMOSA. (Willd.) PLATE 30. *Lappago Aliena*, (Spreng.) *Lappago Biglora*, (Roxb.) *Tragus Occidentalis*, (Nees.) *Phalaris Muricata*, (Forsk.)

*Botanical Characters*.—*Culms* pressing on the earth, and rooting from the joints, 6-12 inches high, ramous—*Leaves* short; *margins* ciliated and waved—*Mouths of sheaths* bearded—*Racemes*

simple, terminal—*Pedicels* short, 2-flowered—*Flowers* lanceolate, echinated on the back, or outside, diverging on all sides round the rachis, the prickles pointing in five different directions—*Calyx* 1-flowered, 2-valved.

*Note*—Found on dry pastures on the Coromandel Coast. It is a small, prostrate grass, which cattle will not eat.

## GENUS 10. ARUNDINELLA.

*Sex* : *Syst* : TRIANDRIA DIGYNIA.

*General Characters*.—*Panicle* compound—*Spikelets* solitary or twin—*Glumes* 3-5 nerved, acuminate—*Lower floret* male, seldom neuter, 2-valved—*Upper floret* hermaphrodite or female, ovate-lanceolate, covered at the base with short hairs—*Awn* long, generally twisted, occasionally very short—*Lower valve* embracing the upper—*Stigmas* plumose—*Caryopsis* oval, beardless.

ARUNDINELLA SETOSA. (*Trin.*) PLATE 31.

*Botanical Characters*.—*Culms* slender, 1-2 feet in height—*Sheaths* hairy; *ligule* ciliated—*Leaves* narrow, 2-3 inches long, above sparingly pubescent—*Flowers* paniced—*Branchlets* subverticelled—*Spikelets* solitary, racemed—*Pedicels* pubescent—*Glumes* unequal, *inferior* smaller, ovate-acuminate, 3-nerved; *superior* acuminate, 5-nerved—*Lower palve* of superior flower slightly 2-cleft, with a twisted awn.

*Note*.—Found in Nepal, Mahabeshwur and Mysore. Cattle will eat it.

## SECTION 3. ANDROPOGONEÆ.

*Spikelets* 2-flowered; lower flower always incomplete—*Valves* more tender than the *glumes*, usually hyaline.

## GENUS 11. ANDROPOGON.

Sex : Syst : TRIANDRIA DIGYNIA.

Origin. From *Aner Andros*, a man, and *Pogon*, a beard, alluding to the tufts of hairs on the flowers.

*General Characters.*—*Spikes* solitary, digitate, or sometimes arranged in a simple or compound panicle—*Spikelets* lanceolate, twin, 2-flowered, 2-valved—*Superior floret* either female or hermaphrodite, *inferior one* male, or neuter—*Glumes* 2, coriaceous, muticous—*Lower valves* hyaline, muticous, or awned—*Ovary* glabrous—*Styles* terminal—*Stigmas* plumose—*Scales* 2, ending abruptly—*Caryopsis* glabrous.

ANDROPOGON CONTORTUS. (Linn.) PLATE 32. *Heteropogon Hirsutus*, (Pers.) *H. Contortus*, (Roem. et Schult.) *Stipa Spicatu* (Thumb.)

*Botanical Characters.*—*Culms* patent, compressed and ramous; the rest 1-2 feet high, erect, and glabrous—*Leaves* below bifarious, upper side scattered with a few hairs; *margins* and *mouths of sheaths* hispid—*Spikes* solitary, terminal—*Rachis* jointed, waved, cylindric; glabrous *below* where the male and neuter flowers are situated; *above* where the female flowers are, it is covered with short, brown hairs—*Flowers* many, imbricated; on lower half all neuter or male, awnless, one pedicelled, one sessile; on upper half, the sessile flower is female, and the pedicelled one male.

*Male flowers.* *Calyx* 2-valved, exterior valve green, and covered with stiff white hair; inner valve glabrous; margins ciliate—*Corol* 2-valved—*Stamens* 3 or none. *Female flowers.* *Calyx* 1-valved, rigid, brown, hispid—*Corol* 1-valved, small; the place of the other is supplied by a long, twisted arista.

*Note.*—This species has been called the *Hygrometric grass*, as the aristæ are very sensitive to moisture; if one of its awns be moistened with saliva or water, it immediately begins to turn round in the hand, and continues to do so for some time. This grass is found in large quantities on all open spaces in the vicinity of Madras. Grows in tufts on rich pasture land all over the

Peninsula, and Western Coast. It is considered good fodder for cattle, and for horses when green.

ANDROPOGON BLADHII. (Linn.) PLATE 33.

*Botanical Characters.*—*Culms* creeping near the base, the rest erect, branched, and bearded—*Leaves* flat, sparingly hairy, especially at the mouths of the sheaths—*Spikes* from 4-8, short-peduncled, fasciculated, sub-alternate—*Joints* and *Pedicel* of neuter spikelet hairy at the margins, uppermost hairs longer—*Inner glume* of the sessile spikelet elliptic, obtuse, upper 3-nerved, glabrous—*Awn* 4 times longer than its own spikelet, scattered below with short, above with long hairs—*Lower spikelet* similar to the upper one.

*Note.*—Found principally in Bengal under bushes, trees, and along the sides of roads. Cattle and horses do not care to eat it.

ANDROPOGON SORGHUM (Roxb.) PLATE 34. *Sorghum Vulgare*, (Pers.) *Holcus Sorghum*, (Linn.) *Holcus Durra*, (Forst.)

*Botanical Characters.*—*Culms* erect, varying in length, thick and very succulent, frequently of a red color or covered with yellowish spots—*Leaves* acuminate, glabrous, except at the sheaths—*Sheaths* very long—*Flowers* in dense ovate panicles, heads deflexed before ripening—*Spikes* in pairs, 1-flowered; one sessile and hermaphrodite, the other bearing stamens only—*Glumes* equal, lower 3-fid—*Palea* 2, transparent, lower one much the larger, acute, concave, upper one bifid, awned—*Awn* pointed—*Stamens* 3—*Styles* 2—*Caryopsis* smooth, white or red.

*Note.*—In places where the arid soil, and scorching influences of the sun are uncongenial to the production of other grain, this millet can be most successfully cultivated. Under such circumstances it becomes a substantive article of food, forming the chief sustenance of the people in the sandy districts of India.

Professor Voelcker, in the following analysis, shows its percentage value as a green fodder.

Water.....	85.17
Flesh-forming matters.....	2.55
Fat and heat-producers.....	11.14
Inorganic matters.....	1.14

The leaves and stalks of this plant is one of the principal fodders for cattle, during the hot season, and is known as *churbi*. In many parts of India it is grown entirely as forage, and not as a grain crop; there it is cut green, before the seed-heads have formed. J. F. Duthie, Esq., B.A., F.L.S.,\* states, "*Sorghum Vulgare* suffers from two diseases. The most peculiar of them, is that in which young *Juar* stalks are liable to become poisonous to cattle, if eaten when partially scorched from want of rain." In proof of which statement he draws attention to the scarcity of rain in 1877, when hundreds of animals were known to perish from this cause, the carcasses becoming inflated with gas (Tympanitis?), and death ensuing shortly after a meal off the young plants. The opinion generally accepted by natives, is that young *Juar* when suffering from want of rain, becomes infested with an insect called *Bhaunri*, to which its poisonous effect on cattle is due. Immediately rain falls the insect is said to perish, and unless the ears of grain have appeared before the rains cease, the crop often recovers itself, and gives a good out-put. Bunt (*Tilletia*) a parasitic fungus, frequently attacks it, converting the whole contents of the grains into a foul, greasy, dark-colored mass; whilst the husk apparently remains healthy.

Stewart considers the grain heating. Cattle are fond of the straw; the latter is also a substitute for forage for horses when grain is not obtainable. (*Hort. Cat.*, p. 704.) The horses of D-B. Royal Horse Artillery were fed on it, for many days, when on the march to the relief of Kandahar in 1880.

*Explanation of Plate 31.*—(1) Upper part of plant showing a spike in flower, and another in fruit—(3 and 4) clusters of spikelets.

ANDROPOGON PERTUSUS. (Willd.) PLATE 35. *Holcus Pertusus*, (Kæn., Linn., Mant. and Willd.)

*Botanical Characters.*—*Culms* procumbent near the base afterward ascending, glabrous, 1 foot high; joints hispid—*Leaves* ciliate, small, glabrous—*Sheaths* hispid—*Spikes* from 4-7, fasci-

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\* "Field and Garden Crops" of the North-West Provinces.



culated : joints and pedicel of male spike villous—*Spikelets* villous below—*Awn* 5 times longer than its own spikelet.

*Note*.—Found everywhere on old pasture lands, especially under the shade of trees. It is considered excellent fodder for cattle, and for horses when green.

ANDROPOGON MURICATUS. (Retz.) PLATE 36. *Antherum Muricatum*, (Beauv.) *Phalaris Zizania*, (Linn.) *Andropogon Squarrosus*, (Linn.) *Vetiveria Oderata*, (Virey.)

*Botanical Characters*.—*Culms* many, glabrous, erect, compressed, jointed, from 5-6 feet high, and as thick as a goose-quill—*Leaves* bifarious at their base, erect, from 2-3 feet long, glabrous, rigid—*Panicle* verticelled, branches numerous, simple, patent—*Rachis* of the spiked-racemes jointed, winding and bare—*Flowers* in pairs and awnless ; one hermaphrodite, the other male and pedicelled. *Male flower*. *Calyx* 2-valved, equal, muricated—*Corol* 2-valved—*Nectary* 2, obcordate—*Stamens* 3. *Hermaphrodite flower*. *Calyx* 2-valved, equal, muricated—*Corolla* 3-valved, membranaceous—*Nectary* 2, obcordate—*Scales* embracing the germ—*Stamens* 3—*Stigmas* feathery.

*Note*.—This grass grows abundantly all over India, except the Punjab where it is found in a few places only. *Edgeworth* states that it is not found within 80 miles of Mooltan, though abundant above that, and the official *bura de jarob*, which is given as an alterative, consists of the upper parts of this plant. The roots are frequently made into an infusion, and used medicinally by the natives, as a *stimulant* and *stomatic*. When finely powdered is greatly used by Hindoos in *liver affections*, also externally as a *refrigerant*. The roots, when dry, and then moistened emit a fragrant odour. A volatile oil is extracted from the roots, and exported to Europe for perfumery. The *culm* of this grass is much used for thatching purposes, &c. Cattle will not eat it.

ANDROPOGON LANCEOLATUS. (Roxb.) PLATE 37. *Batratherum Lanceolatum*, (Nees.) *Batratherum Lanceosolium*, (Trin.)

*Botanical Characters*.—*Culms* ascending from rooting joints—*Leaves* lanceolate, base cordate, amplexicaul, bristle ciliate—*Spikes* in 2 or 4, peduncled—*Rachis* and *pedicel* woolly—*Flower*

sessile, awned; outer *glumes* pectinate-serrulate, and glabrous at the back.

*Note.*—This plant is found on the coast of Coromandel and in Mysore, it closely resembles *Panicum Segerum*.

ANDROPOGON NARDOIDES (Nees.) PLATE 38. *Andropogon Calamagrostis Aromaticus*, (Royle.) *Cymbopogon Pachnoides*, (Trin.) *Andropogon Martini*, (Roxb.)

*Botanical Characters.*—*Culms* erect, simple, from 5-6 feet high, glabrous, and filled with pith—*Leaves* broad and linear, from 1 to 1½ feet long; margins hispid—*Sheaths* glabrous—*Spikes* twin, few-flowered, between fasciculate and panicle, reflexed, forming a supra-decompound elongated panicle—*Rachis* and *pedicels* jointed, silvery-strigose—*Spikelets* glabrous, paired—*Corolla* of the hermaphrodite floret 1-valved, awned, male muticous.

*Note.*—Found in Central India, as far as Delhi. Between the Godavery and Nagpore. It forms the greater part of the Rumnah grass of the Deccan. The roots, &c., have a peculiar smell, something between lemon and turpentine. There are many diverse opinions as to whether cattle will eat the straw. Edgeworth mentions that in the Ambala tract, it is much liked by them, and it is said to give a flavour to the milk and butter, and Royle asserts even to the flesh of animals, feeding on it.

ANDROPOGON HALEPENSIS. (Sibth.) PLATE 39. *Holcus Halepensis*, (Linn. et Schreb.) *Blumenbachia Halepensis*, (Koel.) *Andropogon Arundinaceus*, (Scop.) *A. Avenaceus*, (H. B.) *Sorghum Giganteum*, (Edgew.) *S. Halepense*, (Pers.)

*Botanical Characters.*—*Roots* creeping—*Culms* firm, erect, from 6-8 feet high; *nodes* pubescent—*Leaves* lanceolate, much acuminate to a fine point, glabrous, 2 feet in length—*Margins* and *mouths of sheaths* scabrous—*Panicle* ramous, 1-2 feet long; *branches* verticelled, and covered at their base with silky hairs—*Rachis* scabrous—*Flowers* hermaphrodite, pubescent—*Glumes* oblong—*Pedicels* hairy.

*Note.*—Found throughout India. Stewart states that he has never found this large grass in the Punjab plains, but it is very

common in the Siwalik tract, and in the outer hills to over 5,000 feet. It is at times browsed by cattle, but he was told in Hazara that after eating it they sometimes had fatal head affections.

ANDROPOGON SIMILLIMUS. (Steud.) PLATE 40. *Ischæmum Scrobiculatum*, (Nees.) *Spodiopogon Obliquivalvis*, (Nees.)

*Botanical Characters*.—*Culms* slender, elongated—*Leaves* linear-lanceolate, pubescent, bearded at the base—*Spike* 2-cleft—*Spikelets* ovate—*Lower glume* convex, sub-ventricose, glabrous at the base for a short distance, striated towards the apex, and surrounded by a marginal wing, apex obtuse, 2-cleft, all the margins hooded and bent inwards—*Upper glume* acuminate, bidenticulate, slightly bristly; bristle of the floret twice longer than the spikelet—*Rachis* flattened, broadish, alternately half-forked, twin-flowered—*Joints* and *pedicels* grey-ciliated.

*Note*.—Found throughout the Peninsula. Cattle do not seem to care for it.

ANDROPOGON GRYLLUS. (Linn.) PLATE 41. *Andropogon Paniculatus*, (Lam.) *Apluda Gryllus*, (Beauv.) *Rhaphis Gryllus*, (Nees.)

*Botanical Characters*.—*Culms* erect, rigid, simple or branched, 2-3 feet in height—*Sheaths* glabrous—*Leaves* glaucous, straight and linear—*Panicle* effused, 6 inches long; branches verticelled, elongated, filiform, simple, and hirsute towards the apex—*Glumes* pointed; *inferior* bearded, *superior* 2-toothed—*Awn* twisted and genticulated.

*Note*.—Found in Bengal, Peninsula and Mysore. Useless for fodder, or feeding purposes.

## GENUS 12. APLUDA.

*Sex* : *Syst* : TRIANDRIA DIGYNIA.

*Origin*. From a word signifying chaff; alluding to the appearance of the involucre.

*General Characters*.—*Panicle* compound, 3-flowered—*Involucre* 1-valved, 2-flowered, 1 sessile, and the other pedicelled; it has

also a pedicelled neuter rudiment—*Glumes* 2, muticous, lower one lanceolate, bifid at the apex, to which is attached the upper one, carinate—*Paleæ* hermaphrodite, bi-cleft, muticous or awned—*Stigmas* plumose.

APLUDA COMMUNIS. (Arn.) PLATE 42. *Andropogon Glaucus*, (Retz.) *Apluda Aristata*, (Linn.)

*Botanical Characters*.—*Culms* curving from the base upwards, ramose, from 2-3 feet high—*Leaves* linear-lanceolate, vaginate, petioled, and somewhat bifarious—*Sheaths* glabrous—*Panicle*, involucre of the rays ovate—*Involucel* lanceolate, bifid—*Hermaphrodite flower* awned.

*Note*.—Found all over the Peninsula, generally in the shade, under trees and bushes.

### GENUS 13. ANTHISTIRIA.

*Sex*: Syst: TRIANDRIA DIOYNIA.

*Origin*. From *Anthisteri*, in allusion to the very stiff stubble

*General Characters*.—Polygamous—*Involucre* 1-valved, 7-flowered, and compound—*Hermaphrodite flower* solitary, with a 2-valved, 1-flowered calyx—*Corol* of 1-valve, and an awn—*Accessory florets* male or neuter, 6 in number, 4 sessile and 2 pedicelled.

ANTHISTIRIA CILIATA. (Linn.) PLATE 43.

*Botanical Characters*.—Annual—*Culms* erect, from 1½ to 2 feet high, glabrous, filiform, sometimes coloured—*Leaves* scanty, ensiform, linear, broader at the base, and there more ciliate, especially the floral leaves—*Sheaths* short, and glabrous—*Panicles* erect, often deflexed—*Involucres* longer than the flowers, glabrous, cuspidate—*Hermaphrodite flowers* at their base villous—*Glumes* 2-valved, coriaceous, obtuse, hispid, changing to a dark-brown—*Accessory florets* 6, all neuter—*Glumes* 2-valved, the sessile ones 4 in number, papillose, ciliate near the apex; the upper ones 2, glabrous, and pedicelled.

*Note*.—Found all over India during the rains. Cattle will eat it, but it will not make into hay.

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## GENUS 14. SACCHARUM.

Sex : Syst : TRIANDRIA DIGYNIA.

Origin. From *Sukar*, sugar, its Arabic name.

*General Characters.*—*Spikes* paniced and compound—*Spikelets* lanceolate, girt at the base with wool—*Glumes* equal, and acute—*Florets* 2-valved, awned, or muticous—*Stigmas* plumose, denticulate with simple hairs—*Stamens* 1-3—*Caryopsis* free.

SACCHARUM SPONTANEUM. (Linn.) PLATE 44. *Saccharum Biflorum*, (Forsk.) *Imperata Spontanea*, (Trin.)

*Botanical Characters.*—*Culm* from 1-12 feet high, full of pith—*Leaves* vaginate, acuminate—*Panicle* elongated, adpressed or patent, half-verticelled and spiked; joints and pedicels covered with white silky hairs—*Glumes* acuminate—*Spikelets* 1-flowered, twin, one sessile and neuter; the other pedicelled, hermaphrodite—*Stigma* plumose and purple.

*Note.*—A useless grass for feeding purposes, cattle will only eat it when it is very young and green. Found growing on the sides of rivers, under bushes, and on moist uncultivated lands.

SACCHARUM OFFICINARUM. (Linn.) PLATE 45.

*Botanical Characters.*—*Culms* from 8-12 feet high, thick, and jointed—*Leaves* large, flat, acute, 4-5 feet in length; margins tirrulate, base ciliated—*Sheaths* long, striated—*Ligule* small—*Panicles* terminal, erect, patent, oblong, 1-3 feet long, and of a greyish color due to the quantity of soft hair covering the flower—*Rachis* striated—*Flowers* in pairs, hermaphrodite, 1 sessile, and 1 pedicelled—*Calyx* glabrous, 2-leaved—*Corolla* glabrous, scarious, 1-valved—*Stamens* 3—*Stigmas* 2.

*Note.*—There are many varieties of sugar-cane, and it is found cultivated everywhere in India. The cane suffers severely from the attacks of caterpillars. Cattle and horses eat it readily, is fattening, and makes excellent fodder.

*Explanation of plate.\**

- |                            |                      |                 |             |
|----------------------------|----------------------|-----------------|-------------|
| 1. A full plant.           | 5. Inflorescence.    | 9. Upper glume. | } Enlarged. |
| 2. A leafy offshoot.       | 6. Spikelets.        | 10. Lower „     |             |
| 3. A piece of mature stem. | 7. Stalked spikelet. | 11. A flower.   |             |
| 4. Rizome.                 | 8. The pale.         |                 |             |

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\* Copied from "The Field and Garden Crops."

## SECTION 4. FESTUCACEÆ.

Origin. From the Celtic word *Fest*, signifying pasture, or food.

*Inflorescence* paniculate, compact, or spreading—*Spikelets* several-flowered, generally numerous—*Glumes* 2, unequal, membranaceous, seldom coriaceous, much shorter than the spikelet—*Paleæ* 2, lanceolate; the lower one acute and usually awned—*Awn* straight—*Scales* 2, and membranaceous—*Stamens* 3 or more—*Caryopsis* free, sometimes adherent.

This tribe is very extensive, and found all over the world. The species form a large portion of the pasture vegetation, and are remarkable for the quantity of saccharine matter they contain.

## GENUS 15. ERAGROSTIS.

*Sex* : *Syst* : TRIANDRIA DIGYNIA.

Origin. From *Eros*, love, and *Agrostis*, grass, in allusion to the beautiful dancing spikelets; whence the English name "love grass."

*General Characters*.—*Panicle* compound, or decompound—*Spikelets* 2, or many-flowered—*Glumes* 2, not so long as the spikelet, muticous, and deciduous—*Florets* 2-valved—*Scales* 2—*Stamens* 2-3—*Stigmas* plumose.

ERAGROSTIS CILIATA. (Nees.) PLATE 46. *Poa Ciliaris*, (Roxb., Linn. et Willd.)

*Botanical Characters*.—*Culms* erect, and rigid, 1-2 feet high, at the base procumbent—*Leaves* pubescent—*Panicle* linear, from 4-6 inches long, hispid at the insertion of the branches—*Spikelets* 6-12 flowered, not ciliate—*Corol*, the inner valve ciliate—*Caryopsis* obovate-globose, dark-colored.

*Note*.—Found throughout the Peninsula on dry barren ground. Cattle are fond of it.

ERAGROSTIS PLUMOSA. (Retz.) PLATE 47. *Poa Plumosa*, (Roxb. et Linn.) *Poa Decipiens*, (Link.)

*Botanical Characters*.—*Culms* filiform, spreading at the base, above erect, from 1-2 feet high—*Leaves* linear, mouths and margins of the *sheaths* hispid—*Panicle* oblong, alternate, branches ramous, and their insertions edged with long hairs—*Spikelets* depending, pedicelled, from 4-6 flowered—*Calyx* membranaceous—*Corol* membranaceous, inner valve ciliated—*Caryopsis* oblong, and brown.

*Note*.—Found all over the Peninsula, in tufts on pasture land. Cattle are fond of it

ERAGROSTIS NUTANS. (Retz.) PLATE 48. *Poa Nutans*, (Linn.)

*Botanical Characters*.—*Culms* erect, cylindric, glabrous, from 3-6 feet—*Leaves* elongated, sharp and glabrous—*Panicle* linear, and adpressed—*Spikelets* 8-14 flowered, pedicelled—*Calyx* glabrous—*Corol* glabrous—*Caryopsis* oblong, and brown.

*Note*.—Found along the Coast of Coromandel in rich moist soil, on the borders of rice fields, &c. Makes a good fodder and cattle will eat it.

ERAGROSTIS PUNCTATA. (Linn.) PLATE 49. *Poa Punctata*, (Roxb.)

*Botanical Characters*.—*Culms* erect, simple—*Leaves* small, glabrous—*Sheaths* bearded at the mouth—*Panicle*, the rays simple, expanding; lower ones verticelled—*Spikelets* rather remote, linear, 8-14 flowered—*Caryopsis* oblique, oblong.

*Note*.—Found in Bengal and Mysore. Growing in tufts on pasture land. Cattle will eat it.

ERAGROSTIS CYNOSUROIDES. (Retz.) PLATE 50. *Briza Bipinnata*, (Linn.) *Uniola Bipinnata*, (Linn.) *Poa Cynosuroides*, (Roxb.)

*Botanical Characters*.—*Root* creeping—*Culms* stout, reed-like, clothed at the base with withered sheaths, from 1-2 feet high—*Leaves* numerous, rigid, and very long, especially about the base of the culms; the younger ones convoluted, elongated—*Panicle* linear-oblong, compound; branches scattered, racemose—*Spikelets* many-flowered, secund—*Corol* lanceolate and ovate.

*Note.*—Found in ~~Bengal~~ <sup>Bengal</sup> and Peninsula. This is a coarse strong species, a native of dry barren land. Cattle will eat it.

“ This grass is said to be employed by the Brahmans in their religious ceremonies. *Cusa* or *Cusha*, the Sanscrit name of this much venerated grass, was given to it at a very early period, by the Hindoos, and believed by Sir William Jones, to have been consecrated to the memory of *Cush*, one of the sons of *Ram*.” *Asiatic Researches*, Vol. III.

*Dab* or *Dib*, is found all over the Punjab. Stewart says\* :— “ It is coarse, but is said to be liked by buffaloes, and, having long roots, to remain pretty fresh throughout the year.”

ERAGROSTIS VERTICILLATA. (*Beaux.*) PLATE 51.

*Botanical Characters.*—*Culms* erect, from 1-4 feet high—*Leaves* bifarious and long—*Spikes* erect, compound—*Panicle* many, pedicelled, linear—*Spikelets* from 8-12 flowered, imbricated—*Glumes* linear, tapering to a fine point—*Caryopsis* arilled and oblong.

*Note.*—Peninsula, found growing in moist places. Cattle readily eat it. Would make hay.

## SECTION 5. ROTTBOELLIACEÆ.

*Inflorescence* spicate ; rachis generally jointed—*Spikelets* one or two-flowered ; solitary or in pairs, one being stalked—*Glumes* 1-2, or absent ; usually coriaceous—*Paleæ* membranaceous, seldom awned.

### GENUS 16. HEMARTHRIA.

*Sex* : *Syst* : TRIANDRIA DIGYNIA.

*Origin.* From *Hemi*, half, and *Arthron*, a joint.

*General Characters.*—*Spikes* slightly compressed, half-jointed—*Spikelets* in two rows, two in each joint, one sessile attached

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\* “ Punjab Plants.” By J. L. Stewart, M.D., F.L.S., &c.



to the rachis, and the other pedicelled—*Glumes* free, fertile, 2-flowered—*Flowers* enclosed, hyaline, muticous—*Lower floret* 1-paleaceous, neuter—*Upper floret* 2-paleaceous, hermaphrodite—*Styles* terminal—*Stigmas* plumose—*Scales* 2, truncated, glabrous.

HEMARTHRIA COMPRESSA (R. B.) PLATE 52. *Hemarthria Coromandeliana*, (Steudel.) *Rottboellia Compressa*, (Roxb.)

*Botanical Characters*.—*Culms* several, creeping, ramous, 5-10 feet long, glabrous, compressed—*Sheaths* compressed and glabrous—*Leaves* many, bifarious, glabrous and soft—*Spikes* peduncled, terminal and axillary—*Peduncles* articulated at the middle, and these bracteate—*Flowers* all hermaphrodite, 1-flowered—*Calyx* 1-flowered, 2-valved—*Valves* nearly equal—*Corol* 3-valved, membranaceous—*Stamens* 3—*Styles* 2—*Stigmas* plumose.

*Note*.—Found on the borders of tanks in Bengal and Peninsula, among the roots of other grasses, and brushwood.

## GENUS 17. MANISURIS.

*Sex* : *Syst* : TRIANDRIA DIGYNIA.

*Origin*. From *Manis*, a scaly lizard, and *Oura*, a tail, referring to the appearance of the spikes.

*General Characters*.—Polygamous. *Rachis* jointed—*Hermaphrodite calyx* 2-valved, 1-flowered—*Corol* 2-valved, smaller than the calyx—*Male* or neuter calyx 2-valved, one or two-flowered—*Corol* 2-valved—*Caryopsis* orbicular.

MANISURIS GRANULARIS. (Swartz.) PLATE 53. *Manisuris Polystachya*, (Beauv.) *Peltophorus Granularis*, (Beauv.) *Cenchrus Granularis*, (Linn.)

*Botanical Characters*.—*Root* fibrous—*Culms* ramous, erect, filiform, hispid, from 1-2 feet high—*Leaves* many, hispid, stiff and sharp—*Spikes* terminal and axillary, peduncled, several together—*Glume* of fertile flower coriaceous, wrinkled, and tubercled.

*Note*.—Common on barren lands in the Peninsula. Generally found growing under bushes.

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## SECTION 6. ORYZEÆ.

*Spikelets* 1-flowered, pedicelled—*Glumes*, as a rule, absent—*Paleæ* 2, enclosing the ripe fruit—*Stamens* 3-6.

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## GENUS 18. ORYZA.

*Sex* : *Syst* : HEXANDRIA DIGYNIA.

*Origin*. From the Arabic name *Kruz*.

*General Characters*.—*Spikes* 1-flowered—*Glumes* 2, small, scabrous, muticous—*Valvelets* 2, coriaceous, keeled, and generally awned—*Awn* straight—*Stamens* 6—*Styles* 2—*Stigmas* plumose—*Ovary* glabrous—*Caryopsis* glabrous, oblong.

ORYZA SATIVA. (Linn.) PLATE 54.

*Botanical Characters*.—*Root* fibrous and annual—*Culms* many-jointed and glabrous, from 2-4 feet high—*Leaves* long, vaginate, scabrous—*Panicle* terminal, and branched—*Rachis* flexuose, hispid, and angular—*Flowers* simple, and pedicelled—*Calyx*, *glume* 2-valved, and 2-flowered; the largest valve generally terminating in a hispid, long, colored awn—*Corolla* 1-valved, attached to the seed—*Stamens* 6, hypogynous—*Ovary* glabrous—*Styles* 2—*Stigmas* red, coriaceous, and hispid.

*Note*.—Cultivated throughout India. The original rice plant called by the Telingas "newaree" is found growing in a wild state near the edges of tanks and swamps in the *Circars* and elsewhere. Roxburgh states it is never cultivated, because the produce is so small compared with the varieties in cultivation. Wild rice is white, palatable, and very wholesome. In those places where found growing wild it is carefully collected, and fetches a good price in the market. It is said there are more than 100 different varieties. The various species are divided into two orders, the 1st or early sort is called in Telugu *Poonas*, and the 2nd or late *Pedda Worlu*.

In Porter's excellent treatise, "The Tropical Agriculturist," we find a detailed account of the method of cultivating this grain in China.

"The care of the cultivator begins before the seeds are placed in the earth. The grains destined for that purpose are put in baskets and immersed in water, in which situation they remain for some days; this softens them and tends to hasten their germination. The land which is to be sown with this crop is previously saturated with water until the surface is like soft mud. In this state it is stirred with a plough. A rude kind of hurdle succeeds the plough, the driver sitting on the hurdle to increase its weight, by which means the clods are broken down, and the ground made smooth. All stones are carefully removed, and as far as possible every weed is extirpated. Water is then again let in upon the land in just sufficient quantity to cover its surface, and a harrow with several rows of teeth still further smooths and completes the preparation of the ground. Only those grains which have sprouted in the water are selected for sowing, since, as they have begun to germinate, their goodness is ascertained; all the rest are rejected.

"The seed is sown thickly and evenly on only part of the ground, this serving as a nursery to the rest. A day after the seeds have been sown, the points of the plants appear above the surface of the ground. As soon as the plants have acquired a little strength, they are sprinkled with lime-water for the purpose of destroying insects which might otherwise prey upon the young shoots. This operation is performed with a small basket attached to a long handle, the basket being filled by immersion in another vessel, it is moved over the plants, and the fluid runs through and is thus distributed equally over them.

"The use of lime-water is considered by the Chinese to be so beneficial, that it is said they hold the first inventor of this practice in the highest veneration.

"When the young plants begin to appear in thick vegetation, they are thinned; the superfluous plants being carefully taken up by the roots, and transplanted in a quincunx order in the

unoccupied portion of the land, which has been prepared for their reception. No delay must take place in this work, so that the plants may be as short a time as possible out of the ground: a calm day is usually selected for the purpose. As soon as completed, the water is admitted to overflow the plants. For the advantage of irrigation, the rice fields are usually situated near to a rivulet, pond, or other water, from which they are separated only by a bank, and through this a communication is readily made. Sometimes, however, it happens, that the water is below the level of the fields; in this dilemma, the moisture so essential to the success of the crop is supplied by means of buckets, which is a most tedious and laborious operation. The grounds are kept perfectly clean from weeds, which are taken up by the roots with the hand, although the soil is in such a swampy state, that the labourers employed in this task, cannot step upon the ground without sinking knee-deep; the maturity of the grain is known by its turning yellow in the same manner as wheat; it is then cut, and tied in sheaves, and conveyed to a dry place, where it is threshed."

The method of culture, as practised in India, is very similar to the Chinese mode just described. Transplanting is in most cases pursued, since by that means a much more productive crop is obtained. No artificial tool is required for transplanting rice in India; the finger is the only instrument used for making the hole which is to receive the plant. When this work is over, the plant proceeds through its different stages in a short period of time. In Behar, so rapid is the progress of vegetation, that the first harvest is ready for the sickle two months after planting. The second crop is planted in August and reaped in November, so that two harvests can be obtained from one field.

On the cold mountains of Nepal a mountain rice—*Oriza Mutica*—is cultivated, and differs from the other varieties by the culm being more slender, and seldom attains to more than three feet in height. The seed and awns are also much longer.

"The cultivation of mountain rice does not require the employment of such expensive, or laborious means of irrigation.

The land on which this is to be grown is well hoed and manured: about the middle of March, at the interval of one week between each time, it is again hoed twice or thrice, and the earth is thoroughly pulverized with a mallet. Towards the middle of May, the field is once more slightly hoed after a shower of rain, and the mould is still farther broken and smoothed with the hand. Small drills, at a span's distance from each other, are then made with the finger, which is directed in its straight course by a line. At every span's length in these drills are placed four or five seeds; these are covered by the hand with a very small quantity of mould. In about five days the young plants come up. From the middle of June to the middle of August, attention is paid to the weeding of the ground, the weeds being removed with a spud. At the latter period, when the plants are about two feet high, all the moisture fields of Nepal, where this rice is cultivated, are infested with slugs, worms, and insects. In order to get rid of these, the ryots usually keep a great number of ducks, which at this season are turned into the rice grounds to devour the vermin. The crop ripens in the beginning of September, and by the middle of the month the harvest is gathered in. The ears only are cut off, and the day after they are reaped, the grain is beat out from them, and dried in the sun."\*

Mountain rice finds a congenial situation on the slopes of hills, where it can receive moisture only occasionally, and is capable of sustaining, without injury, a great degree of cold. If the young plants have risen five or six inches above the surface of the ground, before it is covered by the snows of winter, the crop is considered past injury.

"Rice suffers fearfully from a yellowish green fly, called in Bengal *Ganduki* and *Tanki*, and in Madras *Dumpapudu* or *Telyulu*, during the months of August and September."† Rice straw is carefully collected, and used as fodder for cattle. Horses and other animals are fed on it when grass is scarce, but it contains very little nutritious matter.

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\* Heyne's "Statistical Tracts on India."

† "Field and Garden Crops of N. W. Provinces."

## GENUS 19. LEERSIA.

*Sex : Syst :* HEXANDRIA DIGYNIA.

*Origin.* Named after J. D. Leers, a German botanist.

*General Characters.*—*Calyx*; *Glume* 2-valved, and 1-flowered—*Corolla* none.

LEERSIA HEXANDRA. (*Swartz.*) PLATE 55.

*Botanical Characters.*—*Culms* filiform, creeping near the base, joints cylindrical—*Leaves* linear, acute, scabrous—*Spikes* few, alternate, on a deflexed panicle—*Spikelets* solitary.

*Note.*—Horses and cattle are fond of it. Found on the banks of tanks, and moist places.

## SECTION 7. AGROSTIDEÆ.

*Spikelets* 1-flowered, very small—*Callus* either none, obsolete, or present, naked, or bearded with short hairs—*Inflorescence* a raceme, thyrse, or panicle.

## GENUS 20. AGROSTIS.

*Sex : Syst :* TRIANDRIA DIGYNIA.

*Origin.* Derived from the Greek word *Agros*, a field.

*General Characters.*—*Inflorescence* loosely paniced—*Spikelets* compressed laterally, 1-flowered—*Glumes* 2, the upper or inner one smaller, membranaceous, acute, awnless—*Flower* sessile, occasionally with tufts of very short hairs at the base—*Paleæ* 2, inner one rarely absent, unequal; the outer with or without an awn.

AGROSTIS DIANDRA. (*Retz.*) PLATE 56. *Vilfa Diandra*, (*Trin.*)

*Botanical Characters.*—*Culm* simple and filiform—*Sheaths* half the length of the internodes, hairy at the margins—*Ligule* short, ciliate—*Leaves* linear, compressed—*Panicle* linear-oblong, ex-

panding, alternate, compound racemes—*Flowers* in pairs on a common peduncle, unequally pedicelled—*Calyx* valves equal, glabrous, membranaceous—*Stamens* 2—*Caryopsis* obcordate, brown, obtusely rugose.

*Note*.—Found in Lower Bengal, and along the Western Coast, in moist pasture land.

AGROSTIS COROMANDELIANA. (Linn.) PLATE 57. *Agrostis Coromandeliana*, (Retz.) *Vilfa Coromandeliana*, (Beauv.) *Sporobolus Coromandelianus*, (Kunth.)

*Botanical Characters*.—*Culms* spreading near the base, then ascending, from 4-8 inches long—*Leaves* broad, ciliated—*Sheaths* bearded—*Panicle* verticelled, branches simple, secund—*Flowers* in pairs, awuless, unequally pedicelled—*Calyx*, exterior valve small—*Caryopsis* oval, brown, and transversely rugose.

*Note*.—Found on pasture ground in the Peninsula.

AGROSTIS TENACISSIMA. (Linn.) PLATE 58. *Vilfa Orientalis*, (Nees.) *Agrostis Orientalis*, (Nees.) *Agrostis Elongata*, (Roth.)

*Botanical Characters*.—*Culms* ramous, creeping, from 4-8 inches high of their flower-bearing extremities, erect, glabrous, filiform—*Leaves* small and glabrous—*Rays* of the spike-formed juba 3-4, flower-bearing from the base.

*Note*.—Found growing on old, poor, pasture land, where it forms extensive tenacious turf.

## SECTION 8. HORDEÆ.

*Spikelets* one, two, or many-flowered; the terminal flower incomplete—*Glumes* and *paleæ* herbaceous; the former occasionally deficient—*Stigmas* sessile—*Ovary* hairy—*Inflorescence* spicate; *spike* simple, solitary; *rachis* rarely jointed.

## GENUS 21. HORDEUM.

*Sex : Syst : TRIANDRIA DIGYNIA.*

Origin. According to *Bodæus*, the name is derived from *hordus*, heavy ; because bread made with barley is very heavy.

*General Characters.*—*Inflorescence* compact, spicate—*Spikelets* sub-sessile, 3 together on alternate jointed rachis ; the 2 lateral ones of each cluster barren ; the central 1-flowered, perfect, and a second rudimentary—*Glumes* 2, setaceous—*Outer palea* awned, adhering to the fruit.

HORDEUM VULGARE. (*Linn.*) PLATE 59. *Hordeum Hexastichum* (*Linn.*) *Hordeum Distichum*, (*Linn.*) *Hordeum Cæleste*, (*Viborg* ;

*Botanical Characters.*—*Culms* numerous, glabrous, 2-3 feet high—*Leaves* few, linear-lanceolate, tapering to a fine point, glaucous—*Sheaths* striated and glabrous ; *ligule* short—*Spikes* linear, compressed—*Spikelets* sessile, in threes on two sides of a flattened rachis—*Glumes* 2, setaceous, and awn-like—*Palea* 2, 5-ribbed, round on the back and ending in a long stiff awn ; *lower palea* smaller than *upper*, bifid, 2-veined, margins inflexed—*Stamens* 3, exserted—*Ovary* hairy—*Stigmas* 2, plumose—*Caryopsis* (the grain) generally adhering to it.

*Note.*—The country from which common barley originally came is unknown, but many travellers state that it has been found wild in different parts of Northern and Western Asia, as in Tartary, and, more recently in Mesopotamia, also upon the banks of the Euphrates. There are two varieties of barley grown in India, viz., the two-rowed (*Hordeum Distichum*), and the six-rowed (*Hordeum Hexastichum*). The six-rowed barley being the one generally cultivated. In some parts of the inner Himalaya, Thomson mentions a peculiar species of barley called Oú ? (*Hordeum Ægiceras*), cultivated at 11,500 feet. Moorcroft also mentions it in Lahoul and Stewart found it in Pangí. In the latter place it is said to be hardy, but not very digestible.



*Hordeum Hexastichum* is grown as a cold weather crop in the plains of the Punjab, and North-West, as it requires less labour, and gives a better out-put than wheat, even in poor soils, and where the water is deep below the surface. Stewart states that in the Punjab "it is frequently cut two or three times, when young, as fodder, with little or no injury to the ear, which is formed afterwards. In Lahoul and on the Sutlej, a kind of beer is made from its grain, the ferment in the former being brought from Tibet as little farinaceous-looking cakes, the size of a fig, called *pab* or *phab*. In Ladák also a similar beverage is made by the aid of the same substance which is said to be made in Drás to the west, from barley flour, mixed with cloves, cardamoms, ginger, and an herb which is probably an umbellifera (and then fermented ?)."

"The most striking of the diseases to which barley is liable is that commonly known as *Kandwa*, which is the result of the attack of a fungus closely allied to that which causes "smut" in English corn-fields. The first symptoms of the disease is distortion of the ear, and swelling out of the stalk joints. Then a blackish dust makes its appearance on the ear, and at the stalk joints, which rapidly spreads over them and entirely destroys the grain. There are very few barley fields in which some of these distorted charred-looking heads cannot be detected, and they are especially numerous in seasons of good winter rain."\*

## GENUS 22. TRITICUM.

*Sex: Syst:* TRIANDRIA DIGYNIA.

*Origin.* From *Tritum*, rubbed; in allusion to its being originally rubbed down to make it eatable.

*General Characters.*—*Inflorescence* compact, spicate—*Spikelets* solitary, sessile, on opposite sides of a channeled and toothed

\* Field and Garden Crops of the N. W. Provinces.

rachis, 2, 3, or many-flowered; compressed or turgid—*Glumes* 2, opposite, carinate, mucronate, or acute, nearly equal—*Paleæ* 2; outer one acuminate, or awned; inner one bilid at the apex.

TRITICUM SATIVUM (*Linn*) PLATE 60. *Triticum Vulgare*, (*Vill.*) *Triticum Æstivum*, (*Roeb.*) *Triticum Hibernum*, (*Rorb.*)

*Botanical Characters*.—*Culms* many, erect, jointed, hollow and cylindrical, glabrous, striated, glaucous, 2-3 feet high—*Leaves* few, linear, tapering to the apex, ciliated at the base, glaucous—*Spikes* imbricated, 4-cornered—*Spikelets* generally 4-flowered—*Glumes* ventricose, truncate, mucronate, ovate, compressed below the apex, convex on the back, with a midrib extending to a sharp point—*Paleæ* 2, equal, cymbiform, mucronate or awned—*Stamens* 3—*Stigmas* 2, sessile, plumose—*Ovary* obovate—*Caryopsis* enclosed, but not adhering to the paleæ, white, yellow, or red.

*Notg.*—*Triticum Sativum* is an annual cereal, or corn-grass, which under the name of wheat is well-known to every one. Its varieties, though endless, may perhaps be all comprehended under the following heads, of each of which we may have varieties, with more or less hairiness on the chaff-scales, &c. :—

*T. Vulgare Muticum* (*T. Hybernum*, *Linn.*), the awnless or beardless wheat; *T. Vulgare Barbatum* (*T. Æstivum*, *Linn.*); and *T. Spelta*, the grains in which are more or less adherent to the chaff-scales.

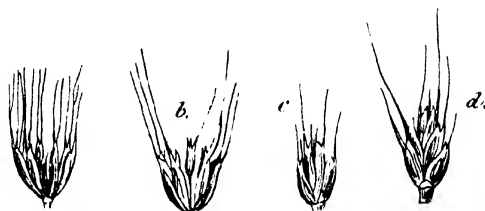
The native country and origin of wheat has ever been a curious subject of speculation. *Professor Buckman* thinks, however, that *M. Fabre's* experiments afford very strong evidence, that this cereal is derived from a wild grass known as *Ægilops*.

“*Ægilops*. A genus of grasses allied to *Triticum*, or wheat grass. It occurs wild in the south of Europe, and parts of Asia. Botanists have recognised as many as three species; but from recent experiments in the culture of *Ægilops*, there is reason to believe, not only that all the so-called species are referable to one, namely, *Æ. Ovata*, but that the *Ægilops* is, in reality, the plant from which has originated our cereal wheats. Upon this

subject will be found an interesting paper, translated from the French, in the *Journal of the Royal Agricultural Society*, (Vol. xv), from which it would appear that M. Esprit Fabre, of Agde, has made the *Æ. Ovata* the subject of experiment, and that from it he obtained the form known as *Æ. Triticoides*, the continued cultivation of which latter, for six years, resulted in the production of very respectable ears of wheat. The changes that occurred were a lessening in the number of the awns, and a gradual conforming of the chaff-scales to those of wheat, a greater length and regularity of growth in the ear, an enlargement of the seed to that of the wheat, and a taller and more upright habit of growth of the whole plant. Both the experimental results, and the conclusions of M. Fabre have been doubted by some of the specific botanists, and we are therefore glad to have an opportunity of recording the result of our own experiments in this interesting matter.

“ In 1854, we planted a plot with seed of *Æ. Ovata*, from which was gathered seed for a second plot in 1855, leaving the rest of the first plot to seed itself, which it did, and came up spontaneously. This plot has since continued to bring forth its annual crop in a wild state, in which the spikes are short and so brittle, that they fall to pieces below each spikelet the moment the seed is at all ripe. The produce of the 1855 crop has, in the same manner, been cultivated year by year in different parts of the experimental garden of the Royal Agricultural College, and our crop for 1860 had many specimens upwards of two feet high, and with spikes of flowers containing as many as twelve spikelets. Our conclusions then are, that with us the *Ægilops* is steadily advancing; and we fully expect, in three or four years, to arrive at a true variety of cereal wheat. What too is confirmatory of this matter, is that the bruised foliage of the wild grass, and the cultivated wheat, emits the same odour, and, besides the *Ægilops*, is subject to attacks of the same species of parasites (blights); our examples of this year being much affected with the rust (*Uredo rubigo*), mildew (*Puccinia graminis*), and others. These, it would seem, are the effects of civilization; and it is not a little

remarkable, that in this respect this grass should be so much like our field crops, which were particularly liable to blight in the straw and foliage during 1860.”\*



*Ægilops* :—*a* *Æ. ovata*; *b* *Æ. ovata triticoides*; *c* the same after four years' cultivation; *d* the same after five years' cultivation.

Wheat is largely cultivated in the Punjab, and North-West Provinces. *T. Æstivum* being the most common. Edgeworth states that rats and white ants are very destructive to it on irrigated lands. “It suffers from red rust (*Trichobasis*), known to the natives as *Rattu* or *Girwi*, and smut (*Ustilago*) as *Kandwa*. These diseases prevail most after heavy rains, followed by cloudy weather. There is also another disease called *Kakhna* (*Polycystis*), which consists of spores; these fill the plant tissues, and is said to prevent a plant from bearing ears.”†

“Of all the diseases this grain is subjected to, mildew is the most injurious, not only to the quantity of the crop, but to its nutritive and healthful quality. Instances of this deterioration are shown by analysis of Agricultural Chemists, as in that of blighted wheat, grown in 1804, by Sir H. Davy, which presented the average quantity of 955 parts of nutritive matter in the 1,000 reduced to 650, while a sample of mildewed wheat in 1806, yield-

\* The Treasury of Botany.

† Field and Garden Crops of the N. W. Provinces.

ed only 210 in the 1,000. The consequence of using such wheat as food, would, of course, be a step toward starvation, even though no greater evil resulted.”\*

Wheat is often cut green—*Kuscel*—and given to horses and cattle as fodder, it must not be cut more than once if grain is also wanted, but several times if otherwise. *Irvine*, however, states that cutting *Kuscel* even once is said to injure the grain.

## SECTION 9. AVENACEÆ.

*Spikelets* 2, or more-flowered; the terminal flower generally incomplete—*Glumes* large, more or less surrounding the spikelets, membranaceous—*Paleæ* membranaceous—*Lower paleæ* generally awned; *awn* mostly dorsal and twisting.

### GENUS 23. AVENA.

*Sex: Syst:* TRIANDRIA DIGYNIA.

Origin. Supposed to be from the Celtic *Aten*, from *Etan*, to eat; whence our word oat has been obtained.

*General Characters.*—*Inflorescence* paniculate, loose and spreading—*Spikelets* pedicelled, compressed laterally, 2 or more-flowered—*Glumes* 2, membranaceous, equal to or exceeding the flowers in length—*Paleæ* 2, lanceolate, frequently hispid at the base, coriaceous, inclosing the fruit; *lower paleæ* 2-cleft at the apex, with a long, twisting, dorsal awn.

AVENA FATUA. (*Linn.*) PLATE 61.

*Botanical Characters.*—*Culms* glabrous, 2-3 feet high—*Leaves* linear, acuminate, scabrous—*Ligule* obtuse—*Inflorescence* generally a simple panicle, peduncles spreading—*Spikelets* deflexed, usually 3-flowered—*Glumes* equal, glabrous, acute, membra-

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\* The Grasses of Great Britain.

ceous; *outer one* smaller, 7-veined; *inner one* 11-veined, carinate—*Outer palea* bifid at the apex, 8-veined, villous at the base—*Inner palea* shorter, with 2 green, marginal, minutely ciliated veins—*Awn* twice the length of flower, twisted.

*Note.*—This is a common field-weed in cereal crops, throughout the Punjab, and is sometimes seen by road-sides, and on waste land. Cattle are fond of the foliage of this grass. In almost all the places where it grows, it is pulled and gathered for fodder. *Madden* mentions that in Kumaon “the straw” is used as fodder, but is suspected of occasionally producing bad effects. At the Royal Agricultural College, *Professor Buckman* made some experiments to illustrate that Cereal or Crop Oats, could be cultivated from *Avena Fatua*. The following is a short account of them:—“In 1852 we sowed a plot of the seeds of *A. Fatua*, collected in 1851; they grew well, but were scarcely different from the wild plant, except in a tendency to an increased plumpness of grain. The produce of this crop was preserved throughout the winter, and sown in a different part of the garden in the spring of 1853; we repeated the process with successive crops in 1854 and 1855, in each of which we noted an increase of tendencies in the following direction: 1—a gradual decrease in the quantity of hairs on the pales; 2—a more tumid grain, in which the pales were less coarse and the awns not so strong and rigid; 3—a gradual increased development of kernel or flour.

“The produce again sown in 1856 had so far advanced, that we collected poor, but still decided samples of what are known as the Potato and Tartarian forms of Oat. These we have gone on improving until, in 1860, we had a quarter of an acre each of good white Tartarian and Potato Oats, as a farm crop, which had been derived from the wild example.

“We may then view the different forms of Crop Oats, as induced varieties from the *A. Fatua*.”\*

AVENA SATIVA. (*Linn.*) PLATE 62.

*Botanical Characters.*—*Culms* erect, smooth, 2-4 feet high—*Leaves* linear-lanceolate, tapering to the apex, light-green, 4-7

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\* “The Treasury of Botany.”

inches in length—*Sheaths* long, striated, glabrous—*Ligule* broad, truncated—*Spikelets* few, compressed, pendulous, in loose panicles, 2-3 flowered—*Glumes* 2, membranaceous, tapering to a thin scarious point—*Paleæ* 2, scarcely so long as the glumes, membranaceous, smooth, bifid, and awned—*Awn* twice as long as the spikelet, rough and twisted at the base—*Stamens* 3—*Styles* 2, white and plumose—*Caryopsis* oval-oblong, hispid.

*Note.*—Oats have only quite recently been introduced into India, they are largely grown in the Punjab and North-West Provinces. At the Hissar Government Farm where there is plenty of water, Oats have been found an invaluable green fodder crop during the cold season ; giving as many as 3 cuttings and then producing a high crop of grain. Stewart says, “ In the records of the Punjab Agri-Horticultural Society it is stated, that in a trial at Jhang, nine maunds of seed gave 260 maunds of crop in straw.”

## SECTION 10. PHALARIDEÆ.

*Spikelets* hermaphrodite, polygamous, seldom monœcious, occasionally 1-flowered, sometimes 2-flowered, either flower hermaphrodite or male ; terminal flower fertile, rest incomplete—*Glumes* generally equal—*Paleæ* often shining, coriaceous in fruit—*Styles* or *Stigmas* elongated into many.

### GENUS 24. ZEA.

*Sex : Syst :* MONECIA TRIANDRIA.

*Origin.* From Zao, to live, in reference to the nutritive properties of the plant.

*General Characters.*—*Male flower* in distinct spikes—*Calyx*, glume 2-flowered, awnless—*Corol*, glume awnless. *Female flower ; Calyx*, glume 2-valved—*Corol*, glume 2-valved—*Style* single, filiform—*Caryopsis* in an oblong receptacle.

• ZEA MAYS. (*Linn.*) PLATE 63.

*Botanical Characters.*—*Culms* glabrous, striated, centre filled with pith, 4-10 feet high—*Leaves* many, linear-lanceolate, glabrous, acute—*Margins* wavy, ciliated—*Flowers* unisexual—*Spikelets* monœcious, 2-flowered—*Glumes* 2, equal—*Paleæ* 2, nearly equal, shorter than the glumes; *lower* 3-nerved, *upper* 2-nerved—*Stamens* 3—*Caryopsis* uniform, compressed, glabrous, red, yellow, white or spotted.

*Note.*—Indian corn was undoubtedly introduced from America quite recently when compared with other cereal crops.

“Miller reckons three species of this plant; Linnæus only one. There are, however, almost endless varieties. A writer who has turned his attention much to this subject says, ‘They are as numerous as the sorts of wheat, of which we know thirty or forty in number.’ The first principal distinctions are white and yellow—early and late—and of each of these are many varieties, which have arisen out of differences of soil, climate, and mode of culture. Some of the varieties do not suffer from cold until the mean temperature falls below 45° Fahr.; and no degree of heat is injurious to it.”\*

“Maize, at the beginning of its growth, is subjected to the attacks of birds and slugs; precaution is therefore necessary until the young plants are three or four inches above the ground, when they will then be quite safe from such attacks. The chemical analysis of this grain shows, that the proportion of gluten is very small, and but little ready-formed saccharine matter exists; whence the inference has been drawn, that it is defective in nutritive properties; but facts are in direct contradiction to this assumption. In countries where maize forms the substantive article of diet among the lower orders, these are usually strong and robust. Horses thrive on this substance when in full work; all domestic animals become fat on this food, and their flesh, at the same time, firm.”†

\* Cobbett on “Indian Corn.”

† “The Tropical Agriculturist.”



Franklin who has written on this subject states:—"To feed horses, it is good to soak the grain twelve hours, they mash it easier with their teeth, and it yields them more nourishment. The leaves stripped off the stalks after the grain is ripe, tied up in bundles when dry, are excellent forage for horses, cows, &c. The meal wetted is excellent food for young, and the old grain for grown fowls."—(*Franklin's Works*, Vol. II, p. 276.)

*Zea Mays* is cultivated all over India. In some parts of the Kashmir Valley, Stewart noticed that it did not exceed 3 feet in height, instead of from 4 to 10 feet in the plains. It is a favourite food of the black bear. The stalks and leaves are given to cattle in India as fodder.

## SECTION 11. STIPACEÆ.

*Spikelets* 1-flowered, not compressed—*Glumes* equal, 'membranaceous—*Lower paleæ* involuted, and awned—*Awn* simple or trifid, generally twisted, articulated at the base—*Ovary* pedicelled.

### GENUS 25. ARISTIDA.

*Sex* : *Syst* : TRIANDRIA DIGYNIA.

*Origin*. Derived from *Arista*, an ear of corn.

*General Characters*.—*Panicle* racemiform—*Spikelets* 1-flowered, bearded—*Glumes* 2, unequal, sometimes muticous—*Paleæ* 2, lower one coriaceous, awned at the apex—*Awn* 3-cleft, occasionally jointed at the base—*Upper paleæ* muticous, and the same size as the scales—*Ovary* pedicelled, glabrous—*Styles* terminal and short—*Stigmas* plumose—*Scales* 2, entire, adnate to the stalk of the ovary—*Caryopsis* terete, involved, and free.

ARISTIDA DEPRESSA. (*Retz.*) PLATE 64.

*Botanical Characters*.—*Culms* ascending, filiform, glabrous, rigid, from 12-13 inches high—*Leaves* few, narrow, glabrous,

nerveless, margins involuted—*Panicle* rigid, divisions spreading, angular, and bearded at the axis—*Calyx*, *glumes* have a large green keel—*Corol* 1-valved, with 3 awns at the apex.

*Note*.—Grows on a dry barren soil throughout the Peninsula, and Malabar. The flowers fall off readily, and are like barbed arrows. A troublesome grass which cattle will not eat.

ARISTIDA SETACEA. (*Retz.*) PLATE 65.

*Botanical Characters*.—*Root* perennial—*Culms* straight, cylindrical, glabrous, about as thick as a crow's quill at the base, from 2-4 feet high—*Leaves* scanty, linear, margins involuted, glabrous and nerveless—*Panicle* deflexed, linear-oblong, with 15-20 erect ramifications—*Calyx* 2-valved, 1-flowered—*Corol* 1-valved, with 3 erect awns at the apex.

*Note*.—Paper-makers construct their frames of the culms; these later tied up in bundles are the brooms of the country. Found growing on a dry, barren soil. Cattle will not eat it.

# APPENDIX.

## SECTION CYPERACEÆ.

Grass-like herbs—*Sheaths* of leaves not split—*Scales* next to the flower, with a median nerve.

### GENUS CYPERUS.

*Sex: Syst:* TRIANDRIA MONOGYNIA.

*General Characters.*—*Culms* solid, foliate, without joints or diaphragms, sometimes angular—*Leaves* glabrous, flat—*Sheaths* entire—*Spikes* mostly capitate or umbellate, fascicled—*Umbels* solitary, compound or supra-decompound—*Scales* or *bristles* none—*Stamens* hypogynous, 1-12, generally 3—*Anthers* 2-celled, innate—*Ovary* 1-celled—*Styles* 2-3—*Stigmas* undivided, seldom bifid—*Caryopsis* crustaceous or bony achene.

Sedges are common throughout the world, and most frequently found on marshy lands, in ditches, and along the sides of running water. There are about 2,000 known species.

CYPERUS ROTUNDUS. (Linn.) PLATE 66. *Cyperus Hexastachyos*, (Rottb.) *Cyperus Hydra*, (Vahl.) *Cyperus Tetrastachyos*, (Vahl.) *Cyperus Bicolor*, (Vahl.) *Cyperus Litoralis*, (Sieb.) *Cyperus Bulbosus*, (Wight.) *Cyperus Temenicus*, (Willd.) *Cyperus Procerus*, (var. *Benghalensis*) (Roxb.)

*Botanical Characters.*—*Root* tuberous, with filiform fibres; tubers dark-brown in color and irregular, fragrant—*Culms* triangular, erect, glabrous, 1-2 feet high—*Leaves* shorter than the

culm, sheathing, flat, glabrous—*Umbels* 3-8 rayed—*Involucre* 3-leaved, unequal—*Spikes* spicately fascicled, linear, compound, 10-50 flowered—*Scales* muticous, carinate and cymbiform—*Style* 3-cleft—*Achenium* obovate—*Racheola* glassy-winged.

*Note.*—The most common species throughout India. This sedge given in a fresh state is demulcent in fevers, and is also useful in diarrhoea and dysentery. The roots are sweet, and slightly aromatic; the taste bitter, resinous, and balsamic. Stimulant, diaphoretic, and diuretic properties are assigned them; and they are further described as astringent and vermifuge (*Pharm. of India*). The tubers are said to taste like potatoes when roasted, and would be valuable for food, only they are so small.

The natives of the Madras Presidency use the tubers at festivals, powdering them up and sprinkling on their gods. We are assured that this sedge is a colic-producer, for we have known of experiments made to prove the point, where horses whose grass ration consisted entirely of Coora suffered from this affection. The roots are eaten by pigs, and the stems and leaves browsed by cattle. *C. Bulbosus* is a troublesome weed in gardens, and difficult to eradicate.

## SUGGESTIONS FOR A BETTER GRASS-SUPPLY.

There are few questions so vexed in Indian Stable Management as the grass-supply, and few that need such urgent reform. We will divide our subject under three heads:—

- (1.) The facilities for the production of forage by the district.
- (2.) The arrangements for the collection and using the same.
- (3.) The systems suggested for the improvement of the supply.

With regard to the production of forage by a district, much depends upon the rainfall, the nature of the soil, and the extent of cultivation. The continuous drought which produced the late famine, played great havoc with the condition of horses all over the country. We have seen during that period grass which was brought in by elephants to the nearest railway station, and so came a journey of 40 and 50 miles into cantonments, on its arrival it was more suited as manure. The horses would hardly touch it, and loss of condition was the consequence.

Every hot weather we have the same complaints about the difficulty in obtaining grass, many of which are real, but still this excuse is frequently used as a pretext for bringing in rubbish.

The quality of grass differs according to the soil of the district, as Mr. Robertson says "on poor soils it (Haraili) is liable to be crushed out by inferior types of plants." Again, soils determine the kind of grass which is best suited to them, for example, the Rumnah grass of Bombay and the Deccan, is a very different fodder from that of Mysore. The latter being coarse, innutritious, and only fit for bedding.

The extent of cultivation materially affects the supply, for in districts where cultivation is carried on to any great extent, the grass-cutters have a much greater distance to go for the forage, and the ryots are naturally very jealous of grass being cut on their lands, for this they look upon as their private property available for home use or for sale.

The arrangements for collecting fodder grass throughout India is, by the grass-cutter system; this system differs in the various Presidencies, and on the proper organization of it rests our horse's condition and health, we will not be departing from our legitimate ground by considering it somewhat carefully.

In Bengal men are employed, they are enlisted and serve for a pension, and each man has a pony; the whole are under the charge of a responsible native, and the grass-cutter has a regulation quantity of grass to bring in daily.

The ponies of these people are a source of great annoyance and anxiety, they require constant inspection, carelessness in this respect is fruitful of sore-backs, mange, and glanders, and the introduction of these two last diseases into troop stables have to be carefully guarded against.

Their pads have also to be fitted, or at least should be, care has to be taken that these animals are fed and looked after, and that none are worked in an unfit state: so that this system which possesses considerable advantages over others to be named, still has its defects.

In Bombay and Madras women are employed, who go out, cut the grass and carry it in.

These women are the horsekeepers' wives, they are of course under no discipline, can go and come when they like, and the means available to compel them to do their work even fairly, are quite insufficient. The only hold we have on them is, that they are wives or relations of the syces, and it suits their purpose to be employed near them and find accommodation for their families in the corps' lines. It would seem superfluous to enter into the evils of this system; women cannot go on service and just when the strain comes there is a total collapse, and a fresh system has to be inaugurated at the very time when the introduction of any new change, cannot help but prove a serious drawback. The women having to walk and carry a load, determines them, naturally, to get that load as near to the lines as possible, good grass is often to be had at some little distance, but the grass-cutter is either unable or unwilling to go that distance for it, and what can be done? Simply nothing, the hands of every one are tied by patent absurdities, and no one knows it better than the woman herself, that you must either go without grass, or put up with the rubbish she chooses to bring in.

It seems probable that no matter what system Government may introduce for the supply of forage to troops, that the grass-cutter system will never be done away with, it is therefore their duty to organize this system, so that corps are in a position to insist on

having the work properly and thoroughly carried out, and the following are the views of officers of experience.

That men should be employed and not women, these men should be enlisted for military service, should serve for pensions, and be under a fixed code of discipline. That in the event of service such an organization could be depended on for work to an extent with which females could never compete, they would be available for the collection of such forage as the scene of action might afford, irrespective of grass, and would otherwise be of inestimable value; to make them thoroughly efficient they should be provided with ponies or mules, which should live in lines attached to their several corps, and be under the supervision, sanitary and otherwise, of the Commanding Officers of corps, the animals would also be of value in any campaign in supplementing the regimental transport. There can be no doubt that such an organization of the grass-cutter system would be attended by the happiest results.

We may here with advantage consider the grass which is supplied to corps under existing arrangements. The most popular error that exists among horse-owners in India, is, that the roots are the parts of the grass that should be given to horses; nothing can be more absurd! That young roots are very succulent, sweet and enjoyed by horses no one denies, but even were young roots always obtainable, it would in our opinion be very doubtful policy to give them entirely; but practically we know that young and old roots are mixed, and the latter are perfect rubbish, innutritious, indigestible and colic-producers, and possess no single advantage of which we are aware. We well know that in condemning a popular prejudice, we will be met with great opposition, and our views severely criticised, but they will stand the test of that by practical experience. Why are bowel affections so frequent during monsoon weather? principally on account of the roots which are then easily obtained, and form the greater part of the grass brought into the lines, unless closely watched. The *post-mortem* examination of fatal cases will prove this.

There is no arrangement which suits a grass-cutter better than

bringing in root grass during the rains, she has only to follow the plough to collect a bundle in a few minutes, or the ground is so soft that with her *mometry* a bundle is soon dug up. In hot weather the attempt to obtain "roots" is a severe task, only the dried-up, innutritious and surface ones are obtained, which is fortunate, or otherwise very large tracts of land would be perfectly bare for some time after the rains.\*

The grass then that should be brought in, should be that which is obtained from above the surface of the ground and no other, it should not be washed, which is done to give it a fresh colour and to make weight. The evils of washing are manifold, but perhaps the greatest objection is, the possible introduction of Anthrax among the horses by grass being washed in water containing the organism, or spores peculiar to this disease. To the unprofessional this may seem a remote contingency, but it is very far from it, the two things are intimately connected, but that is not a matter into which we can enter here.

By wetting the grass, the loss in weight is considerable, for a bundle of 40lbs. wet will only weigh about 14lbs. when dried, or say, a bundle loses 20lbs. by drying, and this is under the average, that is exactly the amount of forage lost to the horses and given in the shape of dirty water.

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\* Throughout all India, besides the destruction of much grass by the close cropping of the flocks, much is destroyed by the mode in which fodder is obtained for horses. The valuable *Hariali* grass (*Cynodon dactylon*) grows abundantly over most parts of the country, but all through the hot weather, when herbage disappears, its very roots are dug up to provide fodder for horses. Deprived of all vegetable covering, it is not to be wondered if the earth dry up. The day must come when pasture fields will be laid down for the herds, and their early adoption should be encouraged. Already in New Zealand grass seed has been introduced from Great Britain, and it is said thrice as many sheep are now being fed on an acre. Moorcroft recommended a trefoil, which he found the people of High Asia using for their cattle.

There are however plenty of grasses from which to select, and consciousness of the necessity for using them alone is wanting. The farmers of India and the villagers generally are, however, wasteful in many ways, and they might seemingly make much more of the natural grasses than they do at present.—(From Surgeon-General Balfour's *Report on the influence exercised by trees on the climate and productiveness of India, 1878.*)



The grass should be brought in dry, laid on a trellis frame, beaten to remove dirt and dust, and it is then fit for use. Perfectly dry grass is not always possible, of course in the rains it is impossible, then they should bring in 20lbs. extra, take every advantage of getting it dry, keep it two or three days, then beat it and use it. In very wet weather, when there is continuous rain, to keep it would only induce fermentation, but as soon as there is a break in the weather, the drying should be assiduously attended to, and it cannot be laid out too thin.

A grass-cutter's bundle is usually composed of a mixture of grasses, of course Hariali should predominate, its characteristics and appearance we have before figured and described, also those grasses likely to be mistaken for it, coarse rank grass should be rejected. A bundle of rubbish can be "dressed" to present a very respectable appearance. To judge of its quality and composition examine it in the centre, note the flowering heads, when there are any, to determine the character of the grass, and pay attention to its colour and odour, dampness or otherwise; yellowness with a foggy smell indicates fermentation and decomposition.

*Suggestions for the improvement of the supply.*

It is evident that as long as Government depends for its grass-supply on a system attended with so many difficulties, and subject to such extreme variation, so long will their horses' bowels be liable to be filled with coarse, innutritious, and in many cases poisonous fodder, to say nothing of it being scanty in quantity, and containing a large amount of dirt and rubbish. These evils, we say, must attend the indiscriminate gathering of grass, especially where the gatherer is an uninterested person. The smaller the quantity, the shorter time it takes to obtain, the more wet and dirt, the heavier the weight; the two are inseparable.

It is to successfully combat these conditions, and also to ensure a regular and unfailing supply of fodder, that the question of farms and other systems have been mooted. In Bengal "ruck lands" exist in or near most cantonments, these are portions of land set aside for the growth of grass, where the corps' grass-cutters go and obtain the daily requirements; certainly not always

of the best, but still it is probably the best to be had, and is certainly preferable to that obtained from tanks, polluted nalas, &c., which is certainly the case where no such arrangement exists. It requires no great genius to discover the evils of the grass-cutter system, nor would it require much to legislate for it effectually, but as the remedies proposed are calculated to prove costly, it does require a deal of consideration, and a practical knowledge of the subject, to propose any plan which would be less expensive than the one extant. The subject resolves itself for consideration under two heads :—

*1st.*—The total abolition of grass-cutters and the establishment of farms, lands, &c.

*2nd.*—The retention of grass-cutters, but under a totally different arrangement.

The abolition of grass-cutters and the establishment of farms, has everything to recommend it except the expense, which would prove of course great; tracts of land would have to be placed aside, manured, ploughed and planted, it would either have to be walled in, or else guarded closely to prevent the inroad of cattle, a certain amount of weeding would have to be done to prevent the soil becoming exhausted early, an establishment must be kept up for this and cropping purposes, and the hundred and one expenses which would naturally occur would all tend to render this an expensive system. The produce of course would be good and under careful management unfailing, the risk of abdominal and anthracoid disease reduced to a minimum, the general condition of the horses improved. It would be beyond our province to enter into a description of what the establishment and management of these farms should consist of, and the principle they should be worked on; we have many and excellent agriculturists in this country, whose experience in these matters would leave nothing to be wished for; but we would here again recommend General Ottley's system having a trial. The chief points to recommend in it are, the enormous output per acre, and the comparatively small tract of land which would be required to produce the necessary quantity; its chief drawback is the irrigation;

but in the Madras Presidency there are only five stations garrisoned by mounted troops, surely enough land could be found near water, to grow sufficient hay for the whole of them. How is all the rice grown for its 34,962,000 inhabitants? A tithe of that used for this purpose, would give enough hay for the whole of India. We pass from the elaborate system of farms and special cultivation, to the consideration of another method whereby forage might be procured; we allude to the system of Government reserving to itself the right of cutting grass in certain districts, and within certain limitations. It is in this manner, we believe, that the horses of the Hyderabad Contingent are foraged, large Rumnahs producing a plentiful supply of most excellent grass, belong to these regiments, the amount required is cut and brought in, at certain seasons it is stacked, and between the stacks and that brought in daily the supply is unfailing. The condition of these horses speak well for this system and the quality of the fodder. We are aware that the Rumnah grass of the Deccan and of Mysore, are two different articles, but then for Bangalore a special system might be introduced to apply to this particular station, where Hariali grows so luxuriantly and to such a size. Here it would seem advisable to place the matter entirely in the hands of land occupiers, who would have the trouble of growing, cutting, and saving the crops, and would sell it to the Commissariat when the operations were completed. There is no doubt that if it was understood that there would be a regular demand for hay, land occupiers in the neighbourhood of Bangalore would cultivate the same in sufficient quantity, and of sufficient good quality to supply the military requirements; and it is not improbable that the same arrangement could be made in other stations in the Presidency. These three systems, viz., Government Farms, Rumnah tracts, and the growth by private individuals are, we believe, the only practicable means of supplanting the grass-cutter's bundle of rubbish, by sound forage.

The retention of grass-cutters but under different management, next demands our attention. We are aware that there are many good arguments against doing away entirely with them, the chief

one being the difficulties likely to occur in engaging these people when going on service, these difficulties we believe to be imaginary; but allowing that they are not, and Government is determined to retain them, as under existing arrangements, the best plan would be to give the supplying of grass into the hands of a contractor (the same as is done with the gram); let him find his own cutters, who bring to the lines daily their forty pounds of grass, hold him alone responsible that the bundle is up to weight, and of the required quality, and punish by fining.

We feel sure that this system would be a great improvement on the present, and as no one knows better how to deal with natives than a native, he could bring in superior grass to what we have now, and save a regiment an enormous amount of trouble.

## GLOSSARY OF BOTANICAL TERMS.

Abortive, imperfectly developed; as abortive stamens, which consist of a filament only; abortive petals, which are mere bristles or scales.

Acaulis, having a short stem.

Acerose, needle-shaped.

Acicula, a bristle. The bristle-like abortive flower of a grass.

Acuminate, narrowing to a point.

Adnate, growing to anything by the whole surface.

Adpressed, lying against anything.

Amplexicaul, embracing; as when a leaf clasps a stem with its base.

Anther, the tip of a stamen.

Apiculus, a small point, coming from an abrupt termination.

Appressed, *see* Adpressed.

Arista, the awn or beard of corn, or some such process.

Articulated, jointed to, and easily separated from.

Ascending, curving upwards from a base.

Awn, a stiff bristle-like process, rising from a glume, or palea.

Axis, the stem, including the root.

Barbs, hooked hairs.

Bifid, cut at the summit into two parts.

Bipaleolate, consisting of two small scales, or paleæ.

Bipartite, divided into two parts nearly at the base.

Biplicate, having two folds, or plaits.

Bractea, a scale, or leaf at the base of a flower.

Calyx, the most external part of the floral envelopes.

Carinate, keel-like.

Caryopsis, the seed, or fruit of a grass.

Ciliated, fringed with hairs.

Clavate, club-shaped.

Compressed, flattened lengthwise.

Conjugate, paired ; when the petiole of a leaf bears one pair of leaflets only.

Convolute, turned inwards from one margin.

Cordate, heart-shaped.

Coriaceous, tough, leathery.

Corol, the petals or leaves of a flower.

Cruciate, having the shape of a cross.

Culm, the stem of a grass.

Cuspidate, tapering gradually into a stiff point.

Cymbiform, boat-shaped.

Decumbent, lying along the ground.

Deflexed, bent downwards.

Deltoid, triangular.

Denticulate, having very fine marginal teeth.

Diandrous, having two stamens in a flower.

Digitate, finger-like.

Distichous, in two rows, or arranged on two opposite sides.

Dorsal, attached at the back.

Elliptic, that which is oval, and acute at each end.

Ensiform, quite straight, with the point acute.

Fasciculate, clustered together ; as when several bodies spring from a common point.

Filament, the thread-like part of a stamen bearing an anther.

Filiform, slender, like a thread.

Fusiform, spindle-shaped.

Genticulate, knee-jointed.

Gibbous, swollen.

Glabrous, smooth, having no hairs.

laucous, sea-green in colour.

Glume, the outer scales of a spikelet.

Hermaphrodite, containing both stamen and pistil.

Hexandrous, six stamens in a flower.

Hirsute, hairy ; covered by long distinct hairs.

Hispid, rough with hairs.

Hyaline, nearly transparent.

Imbricated, overlying like tiles on a roof.

Involucre, applied to two or more leaves, or scales around the base of flowers.

Involute, rolled inwards from opposite sides.

Lanceolate, elliptical, tapering at each end.

Lax, Laxus, said of parts which are distant from each other with an open arrangement, such as the panicle among the kinds of inflorescence.

Ligule, a broad expansion at the base of a grass leaf.

Linear, a line or streak.

Membranaceous, thin and semi-transparent.

Monandrous, having but one stamen in a flower.

Mucro, a stiff point, or short bristle from an abrupt termination.

Mucronate, bearing a mucro.

Muticons, pointless.

Node, that portion of a stem from which a leaf arises.

Ovary, the base of a pistil becoming the fruit.

Palea, the inner scales, or covering of a grass flower, of which there are generally two.

Panicle, applied to a loose, and branched form of inflorescence.

Papillose, granular projections on the surface.

Patent, spreading.

**Pedicel**, a stalk or stem supporting a flower.

**Peduncle**, a stem supporting two or more flowers; its branches are pedicels.

**Pistil**, the central organ of a flower.

**Plumose**, resembling feathers.

**Poa**, signifying grass.

**Procumbent**, lying flat upon the ground.

**Raceme**, an inflorescence in which the flowers are arranged singly on distinct pedicels, along a common axis.

**Racemose**, inflorescence like a bunch of currants.

**Rachis**, the part of a peduncle from which the flowers are borne.

**Ramous**, divided into many branches.

**Scales**, any small processes, like minute leaves.

**Scarious**, shrivelled, dry, or membranaceous.

**Secund**, arranged on one side only.

**Serrated**, having teeth like a saw.

**Sessile**, without stalks.

**Seta**, a stiff hair, or bristle.

**Setaceous**, shaped like a bristle.

**Sheath**, the lower part of a leaf that surrounds the stem.

**Spicate**, having a spike.

**Spike**, a long rachis of sessile flowers.

**Spikelet**, in grasses, is a collection of florets.

**Stamen**, the male organ of a flower.

**Stoloniferous**, bearing runners which root at the joints.

**Stolon**, runners which root at the joints.

**Style**, the stalk which bears the stigma, and intervenes between that and the ovary.

**Terminal**, ending, bounding.

**Triandrous**, three stamens in a flower, as in most grasses.

**Truncate**, terminating abruptly.

**Thyrse**, a panicle whose principal diameter is in the middle, *i.e.* between the base and apex.



Umbel, an inflorescence in which several main flower-stalks spring from the same point.

Umbellate, having the flowers arranged in round flat heads, with the peduncles springing from a common centre.

Unisexual, of one sex.

Vaginate, sheathing ; a petiole rolled round a stem, as in grasses.

Valves, the divisions of the capsule.

Valvular, consisting of valves.

Verticelled, *see* Whorled.

Verticellate, arranged in a circle ; or disposed in a whorl.

Whorl, when the stalks or other organs are arranged like the spokes of a wheel.

Whorled, same as Verticellate.

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# INDEX OF VERNACULAR SYNONYMS.

Tamal (*Tam.*), Bengali (*Beng.*), Hindustani (*Hind.*), Telugu (*Tel.*), Punjabi (*Punj.*), Sanskrit (*Sans.*), Canarese (*Can.*), Malayalam (*Mal.*), Arabic (*Arab.*), Persian (*Pers.*), Guzarattee (*Guz.*), Malay (*Malay*), Dukhanees (*Duk.*).

Agrostis	Coromandeliana...	Tel....	Elika-tunga-gaddi.
"	"	Can. ...	Nari Bálada Henu Hullu.
"	Diandra	Beng...	Bena-joni.
"	"	Can....	Navalu Dondi Hullu.
"	Tenacissima	Tel....	Tomagarika.
"	"	Beng...	Pani-doorba.
"	"	Can....	Billi Garika Hullu.
Andropogon	Bladhii	Beng...	Loari.
"	"	Punj	Bavu.
"	"	Hind...	Loari.
"	"	Tel..	Muka-janoo.
"	"	Tam...	Sukkanaru.
"	"	Can....	Henu Ganjala Garika Hullu.
"	Contortus	Punj...	Palwan, Mingar, Barweza, Surnal, Sureald.
"	"	Hind...	Surári.
"	"	Tel..	Yeddi.
"	"	Can....	Kari Vunagada Hullu.
"	"	Tam...	Panreo Pillu.
"	Halepensis	Punj...	Barú, Borahám, Barúa, Barwa.
"	Lanceolatus	Hind..	Bura-jal-garti.
"	"	Can.	Nela Bidaru Hullu.
"	Muricatus	Tam..	Kasavu Vilamilcham-elai, Vette-Vayr, Valik, Avaru- gaddi, Vattweru, Viela valí.
"	"	Hind..	Gandwr, Bala, Khus-khus, Osia, Useer.
"	"	Beng...	Bena, Khor.
"	"	Tel....	Cooroo-Vayroo, Kussavu.
"	"	Can....	Lavenchi Hullu.
"	"	Punj...	Panni, Khas, Sink, Bura de jarob.

Andropogon Nardoides	...	Beng...	Kurumkoosha.
" "	...	Punj...	Sargara, San, Khawi, Solara.
" "	...	Tam...	Wassaria-pillu.
" "	...	Can...	Bili Dodda Kachi Hullu.
" "	...	Mal....	Kodi-pullu.
" Pertusus	...	Beng...	Kula Mucha.
" "	...	Tel....	Gadi-janoo.
" "	...	Can....	Hennu Ganjalu Garike Hullu.
" Sorghum	...	Beng...	Chota-juar, Junri, Bari-junri.
" "	...	"	Bajra-jhupanwa.
" "	...	Hind..	Kurbi, Jundri, Jondla.
" "	...	Tam...	Cholum, Sakhara.
" "	...	Tel....	Devata-dhamjamu, Jonnalu, Konda-jonna, Ramudi-tal- ambralu, Tella-jonna.
" "	...	Punj...	Joar, Chari, Karbi.
Anthistiria Ciliata	...	Hind...	Bhanjuri.
" "	...	Beng...	Bhaunr.
" "	...	Punj...	Jyotishmuti.
" "	...	Can....	Gantu Nale Hullu.
Apluda Communis	...	Hind...	Gururna.
" "	...	Beng...	Gundha-gurana, Choon-khur- kee.
" "	...	Tel....	Potti-changali.
" "	...	Can....	Sanna Kari Kachi Hullu.
" "	...	Tam...	Myel-Kondai-pillu.
Aristida Depressa	...	Tel....	Nali-pootiki.
" "	...	Can....	Kari Sanna Hanchi Hullu.
" "	...	Beng...	Lamba.
" "	...	Punj...	Spín, Khalak.
" Setacea	...	Tel....	Shipur-gaddi, Cheempirie- kutia.
" "	...	Hind...	Jaree.
" "	...	Tam...	Todapum.
" "	...	Beng...	Jaru.
" "	...	Can....	Dodda Hanchi Hullu.
" "	...	Punj...	Spín, Wege, Jándar.
Arundinella Setosa	...	Can....	Hakki Varji Hullu.

Arundinella Setosa	...	Punj...	Spring, Pitso, Spikso.
" "	...	Beng..	Nágre, Gorwá.
Avena Fatua	...	Punj...	Gozang, Kasamma.
" "	...	Beng...	Ganer, jei.
" "	...	Hind...	Gandal.
" Sativa	...	Punj ..	Jei.
Chloris Barbata	...	Tam ..	Myel-Kondei-pillu, Adavi-godhumulu, Codi-pillu.
" "	...	Mal ...	Konda-pillu.
" "	...	Beng..	Gundha-goorana.
" "	...	Can ..	Hennu Ganjulu Garike Hullu.
" "	...	Tel ..	Konda jeri.
Cynodon Dactylon	...	Punj...	Baráwa, Khabbal, Khabbar, Dúb.
" "	...	Tam ..	Arugam-pillu.
" "	...	Beng ..	Doorba.
" "	...	Tel.. ..	Gericha, Haraili.
" "	...	Sans...	Durva, Shutupurvika, Suhuruveerya, Bharguvee, 'Uurooha, Ununta.
" "	...	Mal....	Arghum.
" "	...	Hind ..	Choto-pine-nutti, Decb.
Cyperus Rotundus	...	Tam...	Kora, Corra.
" "	...	Tel....	Shaka-tonga.
" "	...	Mal....	Kora.
" "	...	Beng ..	Moothoo.
" "	...	Punj...	Díla, Kaserú.
" "	...	Can. ..	Bhadra Hullu.
" "	...	Hind...	Mootha.
" "	...	Sans...	Moosta, Moostuka.
Eleusine Coracana	...	Punj...	Kodra, Mandwa, Mandal, Kutra, Kodon.
" "	...	Tam...	Kayvaru, Ragee.
" "	...	Tel....	Ponassa, Sodee, Ragulu, Taviddu, Pedda ragulu.
" "	...	Hind ..	Natchanee, Munrwee.

<i>Eleusine Coracana</i>	...	Beng..	Murooa.
" "	...	Can.	Sodee Hullu, Ragee.
" "	...	Duk	Ragee.
" "	...	Mal..	Mootaunmy.
" "	...	Sans...	Ràjekà.
" "	...	Malay.	Tsjetti pullu.
<i>Eragrostis Ciliata</i>	...	Can....	Kadu Kambu Hullu ; Kadu Navane Hullu.
" "	...	Punj...	Kuri.
" "	...	Beng...	Kuri.
" <i>Cynosuroides</i>	...	Saus...	Koosha, Kootha, Durbha, Puvitrung, Cusa, Cusha.
" "	...	Tam ...	Aswalayana, Daroha-gaddi.
" "	...	Beng..	Koosha Kush.
" "	...	Tel....	Durbha, Dubha, Dupra, As-nalayana - darbha - gaddi, Kusa-darbha-gaddi.
" "	...	Hind..	Dab, Dib, Koosh, Kusha.
" "	...	Punj...	Dab, Dib, Kúsa, Davolia.
" <i>Nutans</i>	...	Tel....	Urunki-gaddi, Urenka.
" "	...	Can.	Kádu Gasagasé Hullu.
" <i>Plumosa</i>	...	Mal.	Tsjama-pillu.
" "	...	Hind..	Puluka.
" "	...	Beng..	Puluka.
" "	...	Can....	Sanna Purle Hullu.
" <i>Punctata</i>	...	Can..	Bettada Akkabu Hullu.
" "	...	Beng..	Goyalha.
" "	...	Hind..	Tanajinya.
" <i>Verticillata</i>	...	Punj...	Lamb, Mirukar.
" "	...	Beng...	Kúrí.
" "	...	Hind..	Chinka.
" "	...	Can.	Kadu Sanna Samé Hullu.
<i>Hemarthria Compressa</i>	...	Beng..	Panie-Shira, Pansheru.
" "	...	Hind..	Panie-shir.
" "	...	Can....	Sunku Dabbé Hullu.
" "	...	Tel....	Shervoo.
<i>Hordeum Vulgare</i>	...	Punj...	Grim? Elo? Ūá, Ūjan, Thanzatt, Nai, Jawa, Chák, Búza, Jáwa-khár.

Hordeum Vulgare	...	Sans...	Vuva, Situshooka.
" "	...	Beng...	Juba, She-eer.
" "	...	Tel...	Pàchcha-yàvà, Yàvàlu.
" "	...	Tam...	Bàrlee Arisee.
" "	...	Guz..	Jàw.
" "	...	Pers...	Jow.
" "	...	Hind...	Jow.
" "	...	Duk...	Jow.
Lappago Racemosa	...	Tel....	Java Viygamee, Pachcha-yava.
" "	...	Tam...	Ottarai.
" "	...	Can...	Puttu Anta-purlee Hullu.
Leersia Hexandra	...	Mal....	Nir-valli-pullu.
" "	...	Beng..	Kolshia.
" "	...	Hind...	Jungli dal.
Leptochloa Chienensis	...	Can....	Kádu Sanna Kari Sajje Hullu.
" "	...	Punj...	Chubrei.
" "	...	Hind...	Bura-pini-nuti.
Manisuris Granularis	...	Can....	Kádu Sanna Hárka Hullu.
" "	...	Hind...	Trinpali.
" "	...	Beng..	Trinpali.
" "	...	Tel....	Nali-poonookoo.
Microchloa Setacea	...	Beng...	Pansheroo.
" "	...	Hind...	Panshiru.
" "	...	Tel....	Kunda-punookoo.
" "	...	Can....	Navalu Bannada Hullu.
" "	...	Punj...	Samá.
Oryza Sativa	...	Tam...	Nelloo, Aresee.
" "	...	Hind...	Dhan, Chawl, Pusnee.
" "	...	Beng..	Pasuel, Dhan, Pusni.
" "	...	Tel...	Oori, Cheni, Beem, Erra-jilama-vadlu.
" "	...	Sans...	Unoo, Dhanya, Vrihi.

<i>Oryza Sativa</i>	...	Punj...	Tái, Dein, Tání, Dhán, Bás-matí, Chita.
" "	...	Can....	Cheni, Beeum.
" <i>Mutica</i>	...	Sans...	Nivara.
" "	...	Tel....	Newaree, Aruz.
<i>Panicum Ægyptiacum</i>	...	Tam...	Mutthenga Pillu, Shegapu, Shamai.
" "	...	Mal....	Cavara-pullu.
" "	...	Hind...	Makura-jali.
" "	...	Beng...	Makura-jali.
" "	...	Tel....	Kar-sodi.
" "	...	Can....	Kónana Tale Hullu.
" <i>Brizoides</i>	...	Tel....	Oda.
" "	...	Can....	Antee Garike Hullu, Kadee Haraka Hullu.
" <i>Burmanni</i>	...	Can....	Banjo Gariké Hullu.
" <i>Colonum</i>	...	Punj...	Gangli Samak.
" "	...	Beng..	Shama.
" "	...	Can..	Jade Shamkara Hullu.
" <i>Crus Galli</i>	...	Can....	Kadu Dabbe Hullu.
" <i>Erucæforme</i>	...	Tam...	Cinna Arricam.
" "	...	Can...	Antu Gariké Hullu.
" <i>Fluitans</i>	...	Tel..	Doosa.
" "	...	Can....	Gaddi Vadavina Hullu.
" "	...	Beng..	Petinar.
" "	...	Hind..	Petinar.
" <i>Frumentaceum</i>	...	Tel....	Boota-Shama, Arikéhloo, Arunga.
" "	...	Tam..	Chamalu, Waroogoo.
" "	...	Beng..	Damra-Shama.
" "	...	Hind..	Kodow.
" "	...	Can..	Hárákah.
" "	...	Duk...	Kodorow.
" "	...	Guz..	Khodra.
" "	...	Sans...	Kodrāvâhà.
" "	...	Mal....	Schama.
" "	...	Punj...	Sámúka, Samá, Sánwak.
" <i>Glaucum</i>	...	Can....	Bili Korale Hullu.
" "	...	Tel..	Naka-korra, Verashamai.
" "	...	Beng..	Pingi, Natchi.
" <i>Indicum</i>	...	Tel....	Kuroor-soloo.
" "	...	Beng..	Malankur.
" "	...	Hind...	Malankur.
" <i>Italicum</i>	...	Tam...	Tenuay.

Panicum Italicum	...	Guz....	Kāng.
" "	...	Duk....	Rāulāw.
" "	...	Hind....	Gungnee.
" "	...	Mal....	Nāvārā.
" "	...	Tel....	Corāloo.
" "	...	Arab....	Dokhu.
" "	...	Malay..	Tenna.
" "	...	Pers ...	Arzum.
" "	...	Sans. .	Prayingoo.
" "	...	Punj...	Kangū, Chīrr, Kher.
" Jumentorum	...	Can....	Ruska Hullu.
" "	...	Tel ...	Sama Kussa.
" "	...	Punj...	Male, Shamūkha, Garm, Girūi, Mangrūr.
" "	...	Tam ..	Shonai Pillu.
" Miliaceum	...	Saus...	Vrechile-heda, Unoo.
" "	...	Hind..	Cheena.
" "	...	Beng...	Cheena, Cheeno-ghas.
" "	...	Tel....	Worga, Worgle.
" "	...	Punj...	Chīna, Chīnwar, Chīnī Anna,
" "	...		Sālan, Rad.
" "	...	Pers ...	Arzan.
" "	...	Tam ...	Varagoo.
" Miliare	...	Tam ..	Kādānnny, Shama-pillu.
" "	...	Tel....	Nalla Chāmalu, Nella-shama.
" "	...	Mal....	Kuren-pullu.
" "	...	Beng...	Kootkee.
" "	...	Punj...	Kútkí.
" Peteverii	...	Tam ...	Korani.
" Prostratum	...	Tel....	Bura-jal-ganti.
" "	...	Can....	Kadu Samma Sámé Hullu..
" "	...	Hind...	Bura-jal-ganti.
" "	...	Beng...	Bura-jal-ganti.
" "	...	Can....	Kadu Karí Sámé Hullu.
" Psilopodium	...	Beng...	Chota-jol-ganti, Korunkoo-
" Repens	...		sha.
" "	...	Hind..	Chota-jolgantee.
" "	...	Can....	Sonti Hullu.
" "	...	Tam...	Sukkānāroo Pillu.
" "	...	Tel..	Allapu Kommu-vélla Vanti
" "	...		Gaddi.
" Sanguinale	...	Beng...	Chiri-chira.
" "	...	Can...	Gandu Akkibu Hullu, Bili
" "	...		Akkabu Hullu.
" "	...	Tam...	Melampary, Pishachu.
" Spicatum	...	Guz ..	Bājāri.



<i>Panicum Spicatum</i>	...	Hind...	Banjerà.
" "	...	Beng...	Bajra.
" "	...	Duk ...	Banjerà.
" "	...	Tam ...	Chumboo.
" "	...	Mal....	Muttèree, Tenna.
" "	...	Tel....	Sujilloo.
" "	...	Punj...	Bájra.
" "	...	Saus...	Cunghoo.
" <i>Verticillatum</i>	...	Tam ...	Koodraywálie Chàmay.
" "	...	Hind...	Lupta, Dora-Vijara.
" "	...	Tel....	Chikilinta Gaddi.
" "	...	Can....	Sama Anta Purla Hullu.
" "	...	Beng ..	Dora-biaroo.
<i>Paspalum Scrobiculatum</i>	...	Tel....	Arú, Asakalu, Nalea Asakaul, Níráruga, Páta, Arige Chettu.
" "	...	Beng...	Koda.
" "	...	Hind...	Koda.
" "	...	Punj...	Kodra.
" "	...	Can ...	Háraka Hullu.
<i>Saccharum Officinarum</i>	...	Tel....	Sákkara, Panchádàra, Cheruka bodi.
" "	...	Pers...	Shukir.
" "	...	Arab...	Shukir.
" "	...	Beng...	Shukir, Ik, Kajooli, Ukh, Ook, U Khan.
" "	...	Tam ...	Sukhàréi, Karumbu, Nullavellum.
" "	...	Hind...	Chenee, Ganna, Gunna, Ik, Uch, Ikhari.
" "	...	Mal....	Goolà, Karimba.
" "	...	Punj...	Ganna, Kamánd, Panuda.
" <i>Spontaneum</i>	...	Tam ...	Nanel.
" "	...	Hind...	Kash, Cas, Kagara.
" "	...	Beng...	Kagara, Khugura.
" "	...	Tel....	Rallugaddy, Billoo-gaddi, Kaki-Veduru.
" "	...	Can....	Hodake Hullu.
" "	...	Punj...	Kán, Káhi.
<i>Trachyzus Mucronata</i>	...	Can....	Mara Akkabu Hullu.

Triticum Vulgare	...	Tam...	Godumbay Árisee.
" "	...	Guz ...	Gawn.
" "	...	Duk ...	Génng.
" "	...	Tel....	Godoomàloo.
" "	...	Mal ...	Gendoom.
" "	...	Punj...	Rozatt, Dro, Do, Zud, Kanak.
" "	...	Pers ...	Gandum.
Zea Mays	...	Tam...	Mukka Cholum.
" "	...	Duk ...	Mukka Jàrie.
" "	...	Tel....	Mokkù Zonáloo, Mokkajon- nalu, Mosanam.
" "	...	Hind..	Bhoottàh.
" "	...	Malay.	Jaggon.
" "	...	Sans...	Vávánàlà.
" "	...	Punj...	Makki, Makkei, Mak, Kúkrí, Bará Joár.



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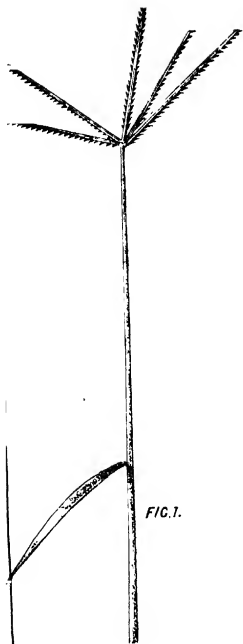


FIG. 1.

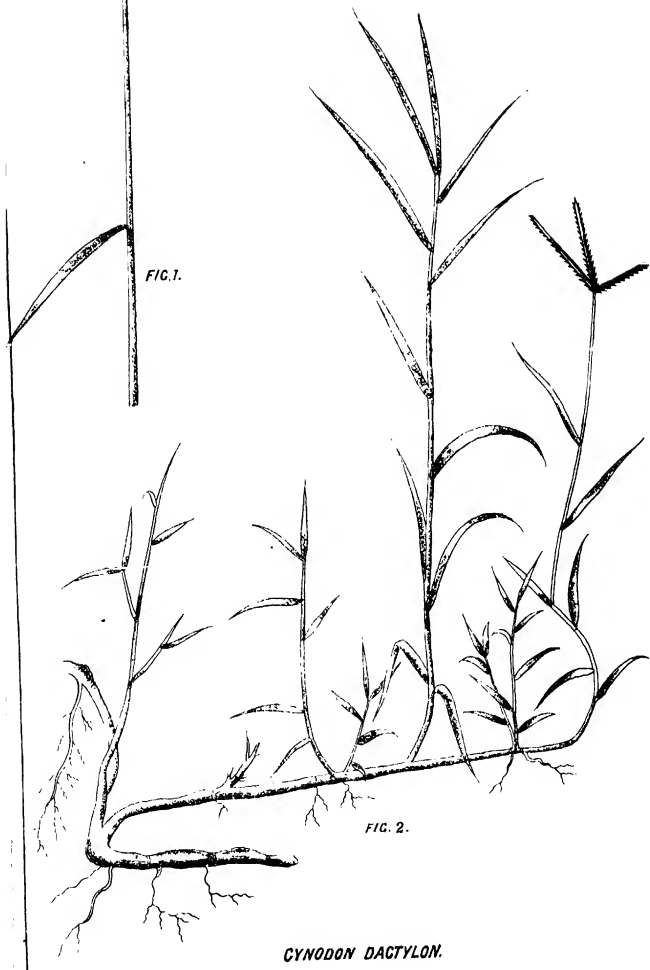


FIG. 2.

*CYNODON DACTYLON.*







*CYNODON DACTYLON.*



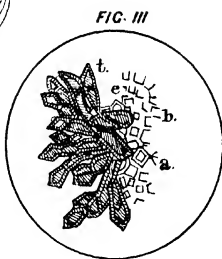
**USTILAGO (SMUT)**



**FIG. I.**



**FIG. II.**



**FIG. III**

- a. Mass of teleutospores
- t. On a leaf of Dhoo grass
- e. Epidermis ruptured
- b. Sub epidermal fibres

**CYNODON DACTYLON.**





*MICROCHLOA SETACEA.*





*LEPTOCHLOA CHINENSIS.*







*CHLORIS BARBATA.*





*ELEUSINE CORACANA.*





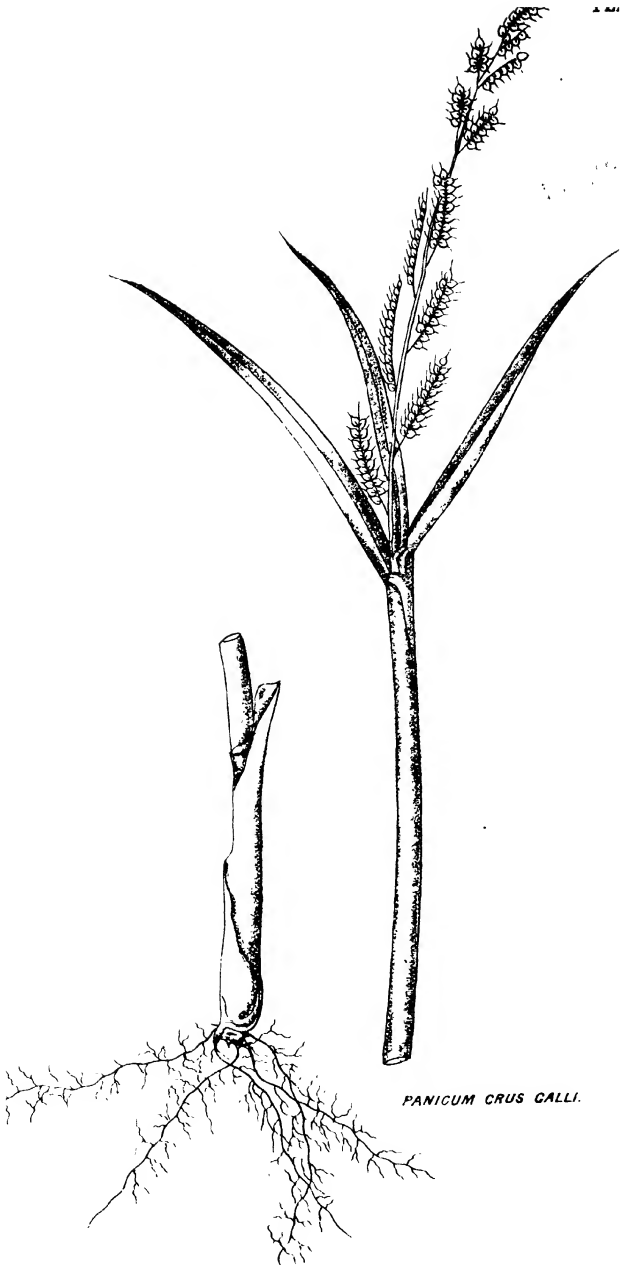
*PANICUM FLUITANS.*











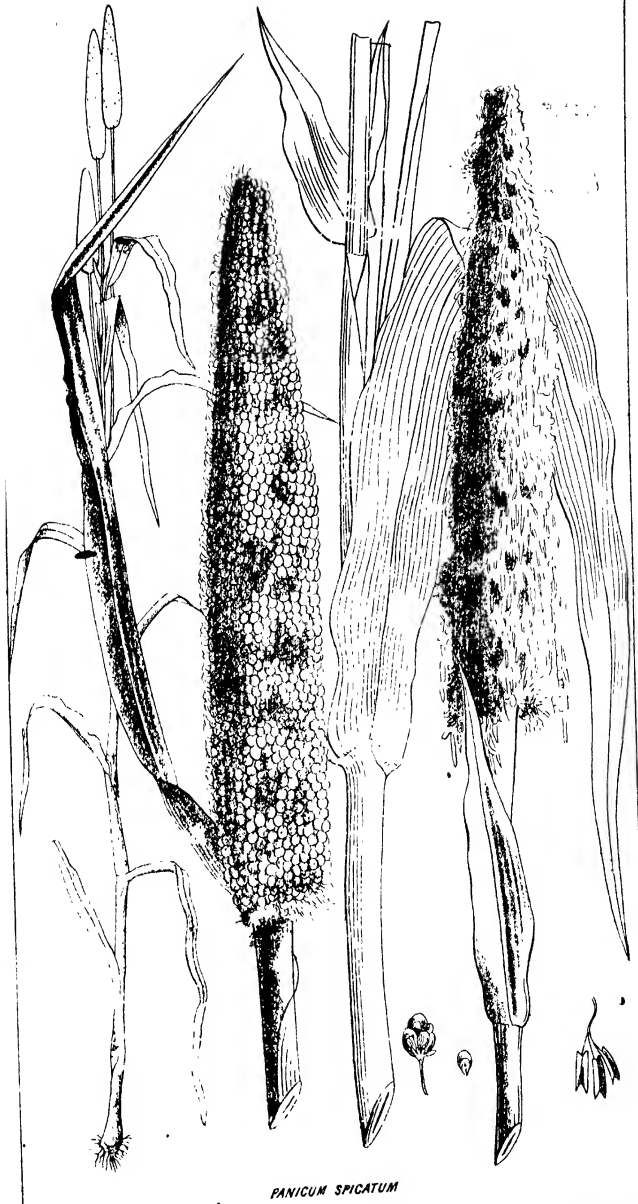
*PANICUM CRUS GALLI.*





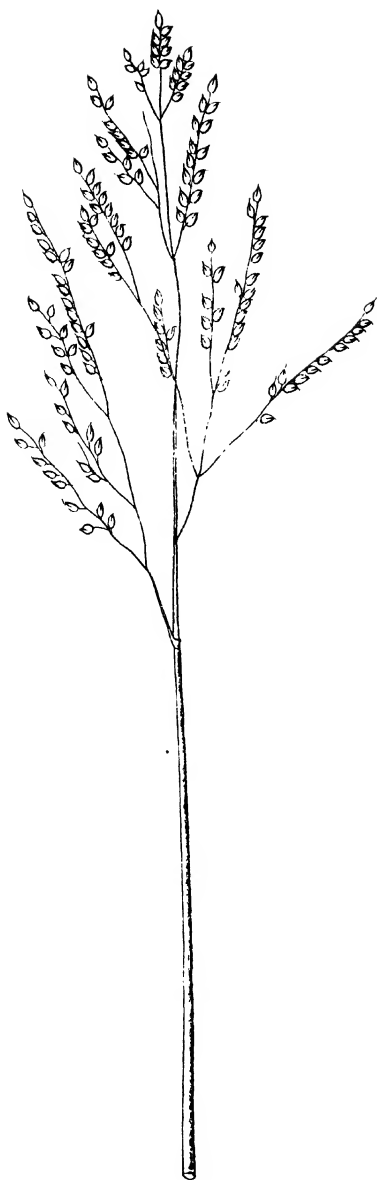
*PANICUM BURMANI*





*PANICUM SPICATUM*





*PANICUM REPENS.*

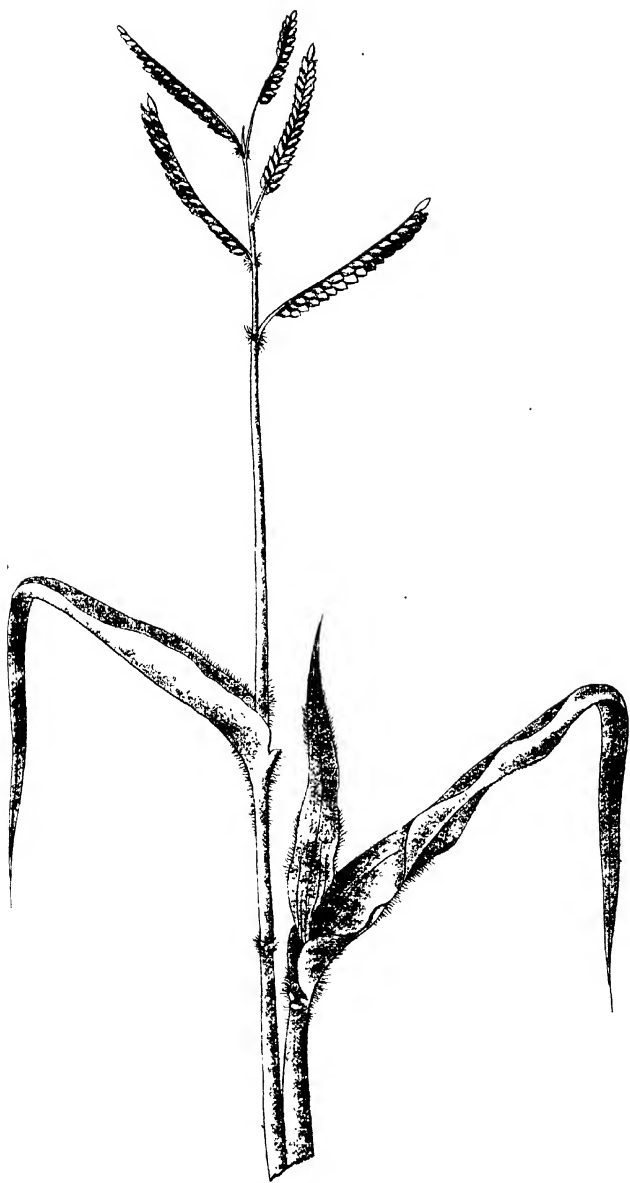






*PANICUM ANTIPODUM.*





*Panicum petevern.*





*PANICUM ERUCÆFORME.*





PANICUM JUMENTORUM







1949



**PANICUM MILIARE**





*PANICUM MILIACEUM*





*PANICUM ITALICUM*





*PANICUM PSILOPODIUM.*

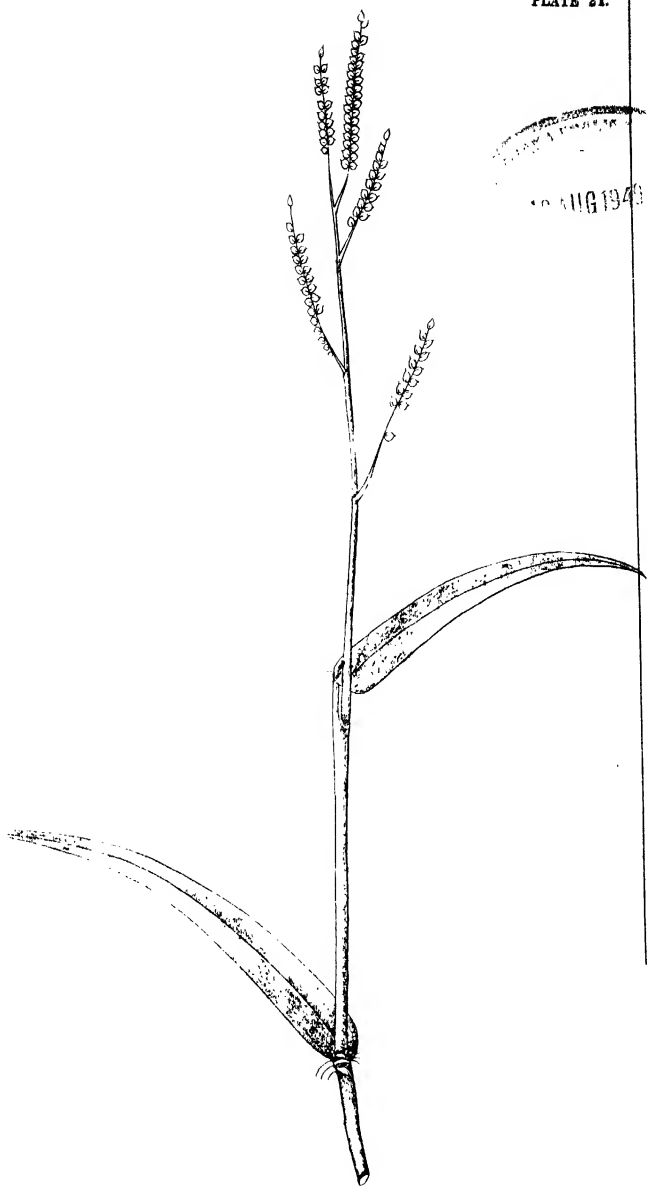






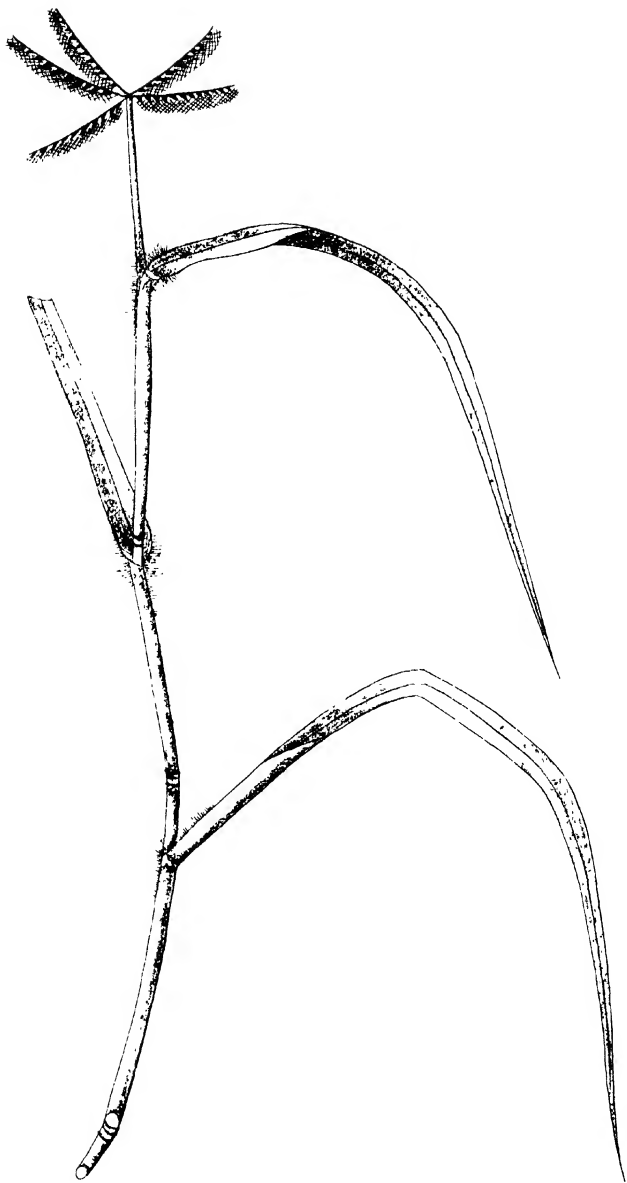
*PANICUM BRIZOIDES.*





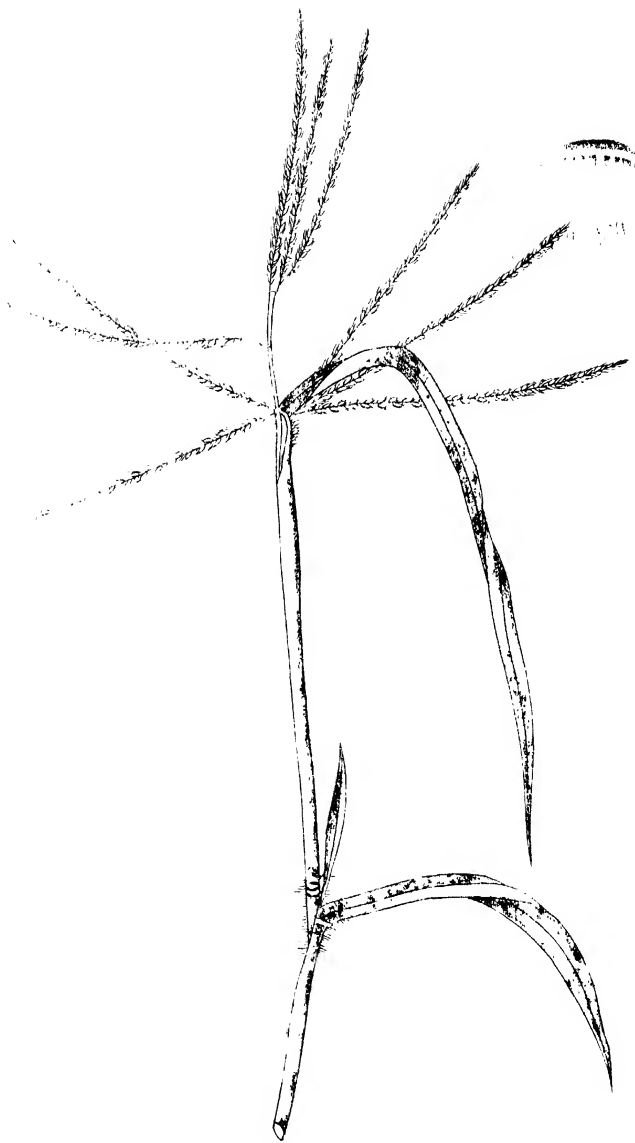
*PANICUM PROSTRATUM.*





*PANICUM EGYPTIACUM.*





*PANICUM SANGUINALE*

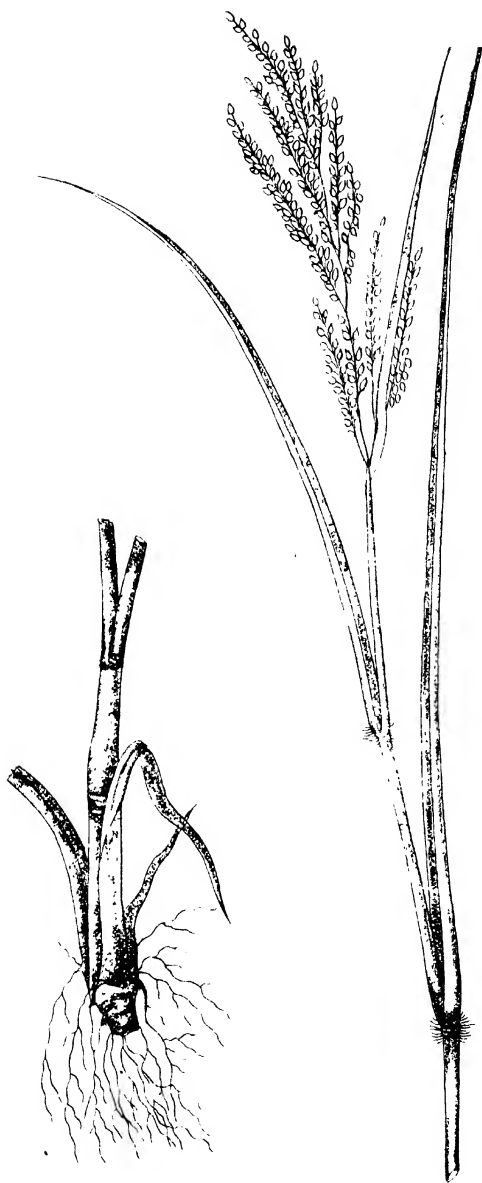






*PANICUM COLONUM*





*PANICUM FRUMENTACEUM.*





**SETARIA CLAUCA.**

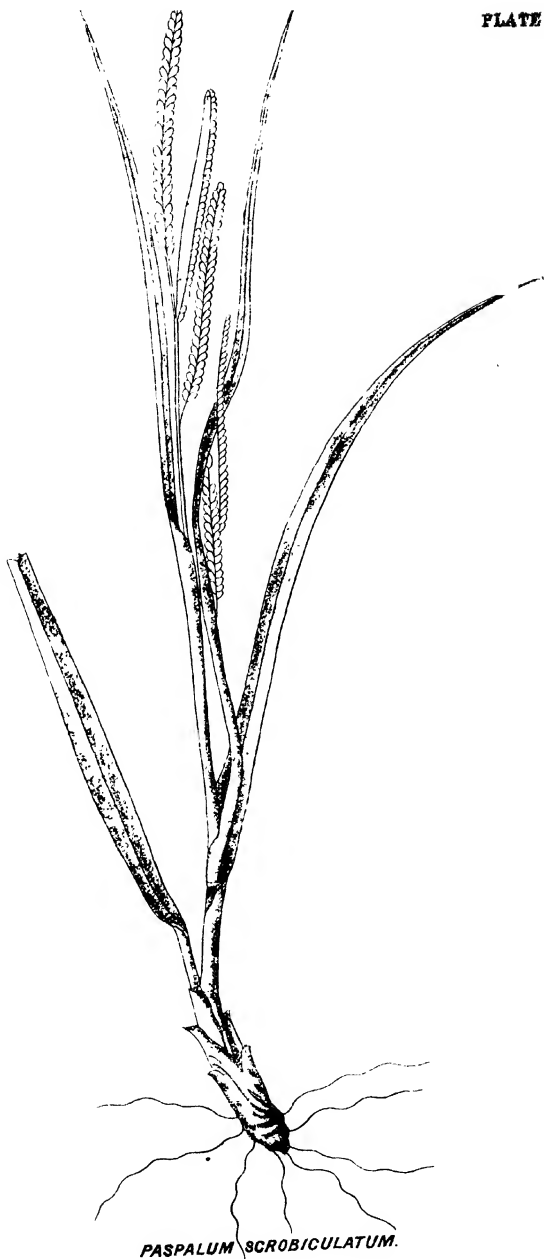




**SETARIA VERTICILLATA**







*PASPALUM SCROBICULATUM.*





*TRACHYS MUCRONATA*





*LAPPAGO RACEMOSA*



PLATE 32

17 AUG 1949



ARUNDINELLA SETOSA







*ANDROPOGON CONTORTUS.*



PLATE 58.



ANDROPOGON BLADHII.





*ANDROPOGON SORGHUM.*

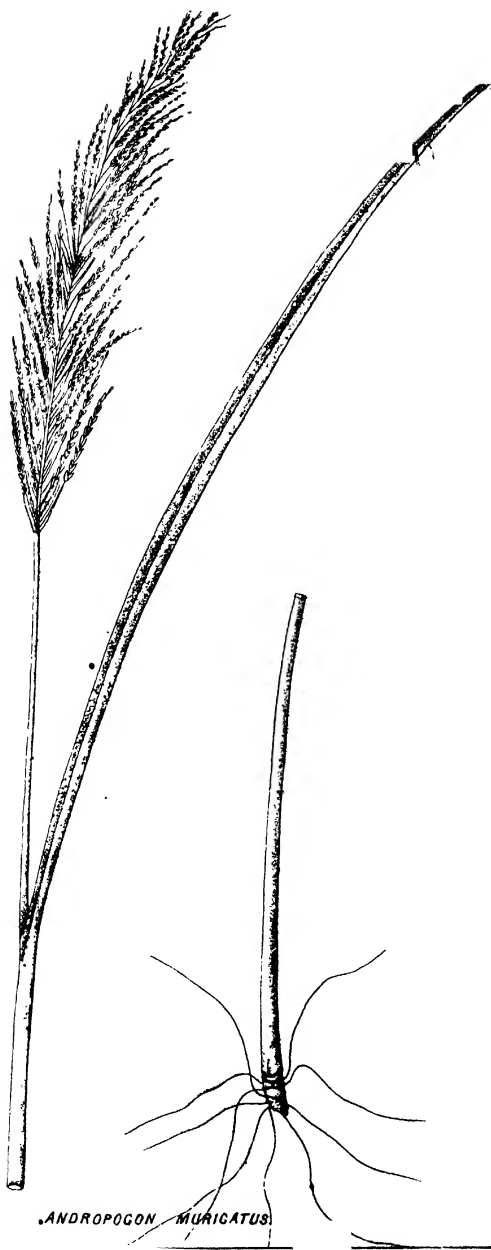




*ANDROPOGON PERTUSUS*







*ANDROPOGON MURICATUS*





*ANDROPOGON LANCEDOLATUS.*





*ANDROPOGON NARDOIDES.*





*ANDROPOGON HALEPENSIS.*







*ANDROPOGON GRYLLUS.*





*APLUDA COMMUNIS*





*ANTHISTIRIA CILIATA*





**SACCHARUM SPONTANEUM**

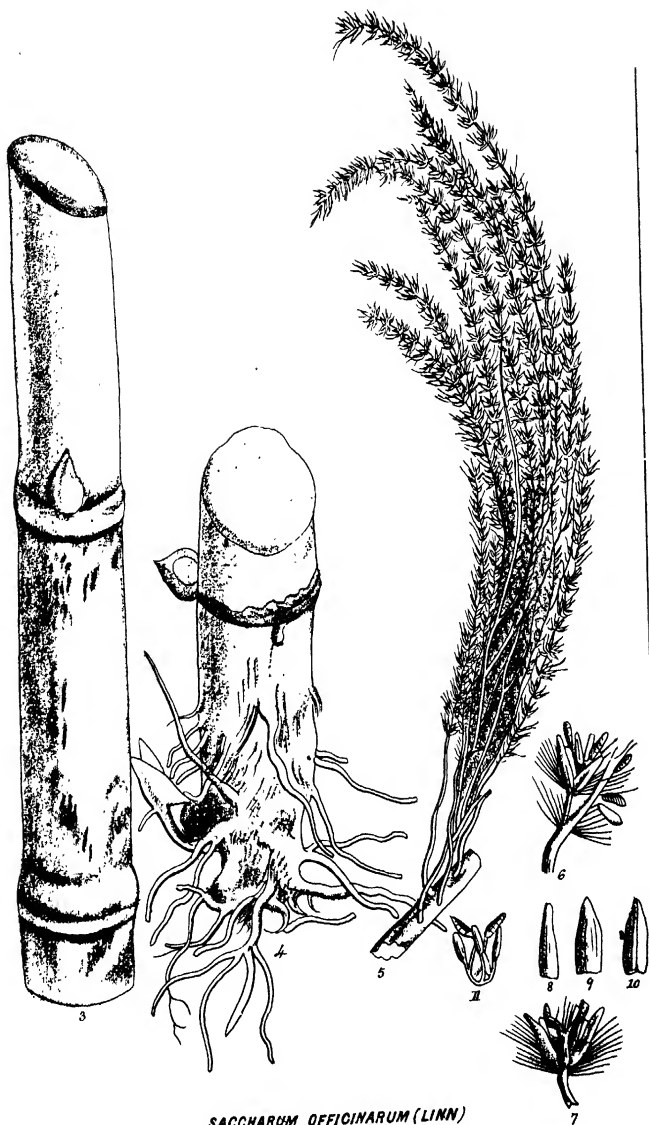






SACCHARUM OFFICINARUM (LINN.) 1.





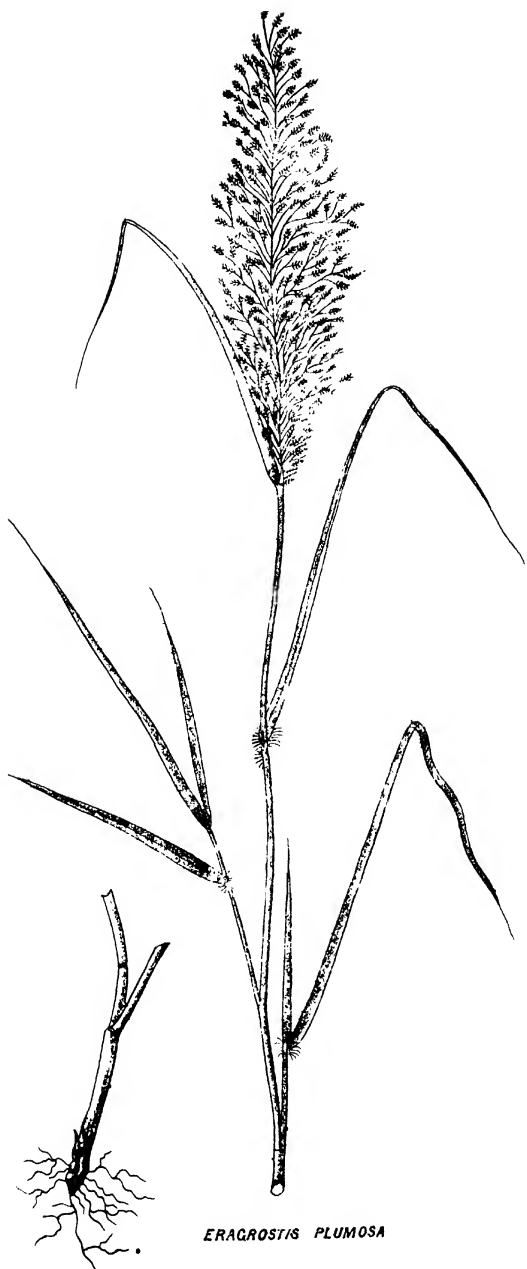
*SACCHARUM OFFICINARUM* (LINN)





*ERACROSTIS GILVATA*





*ERAGROSTIS PLUMOSA*







*ERAGROSTIS NUTANS*





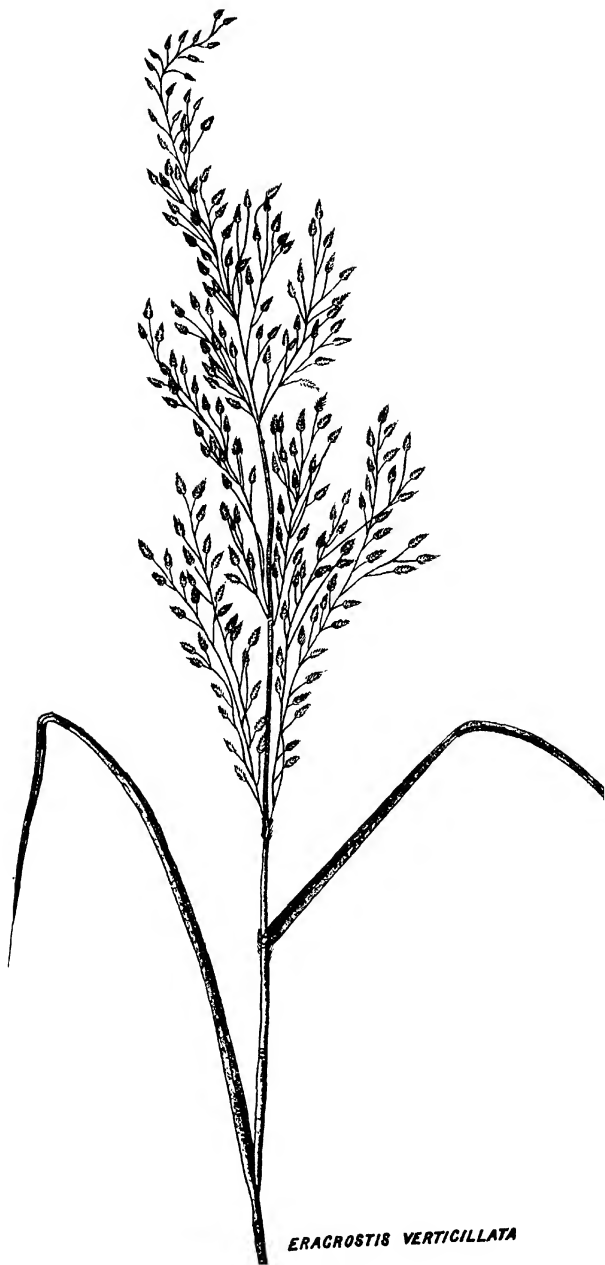
*ERAGROSTIS PUNCTATA.*





*ERAGROSTIS CYNOSUROIDES.*





*ERACROSTIS VERTICILLATA*

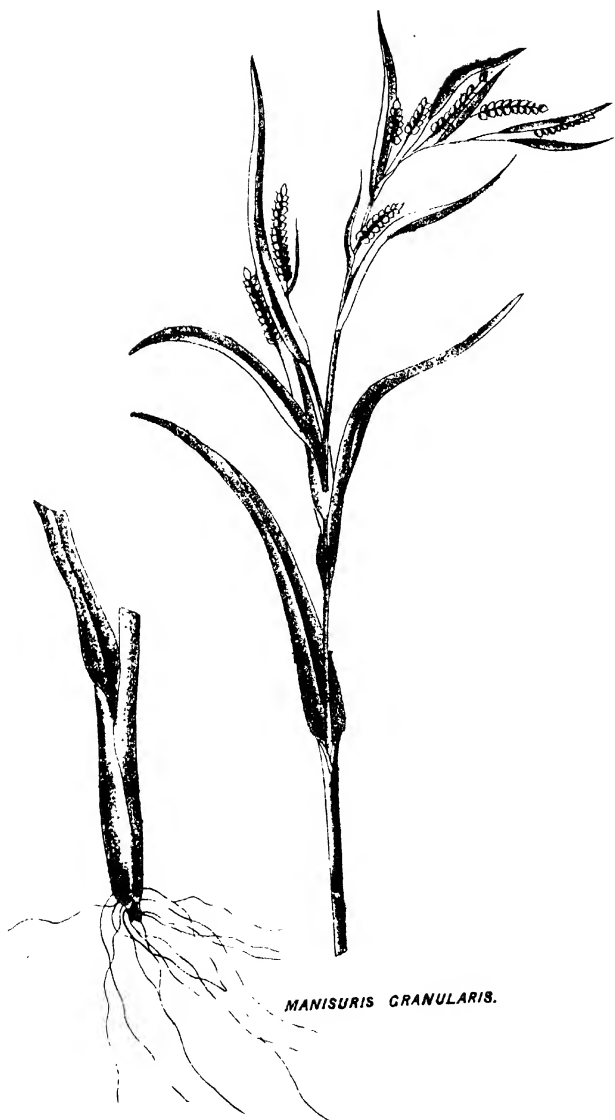






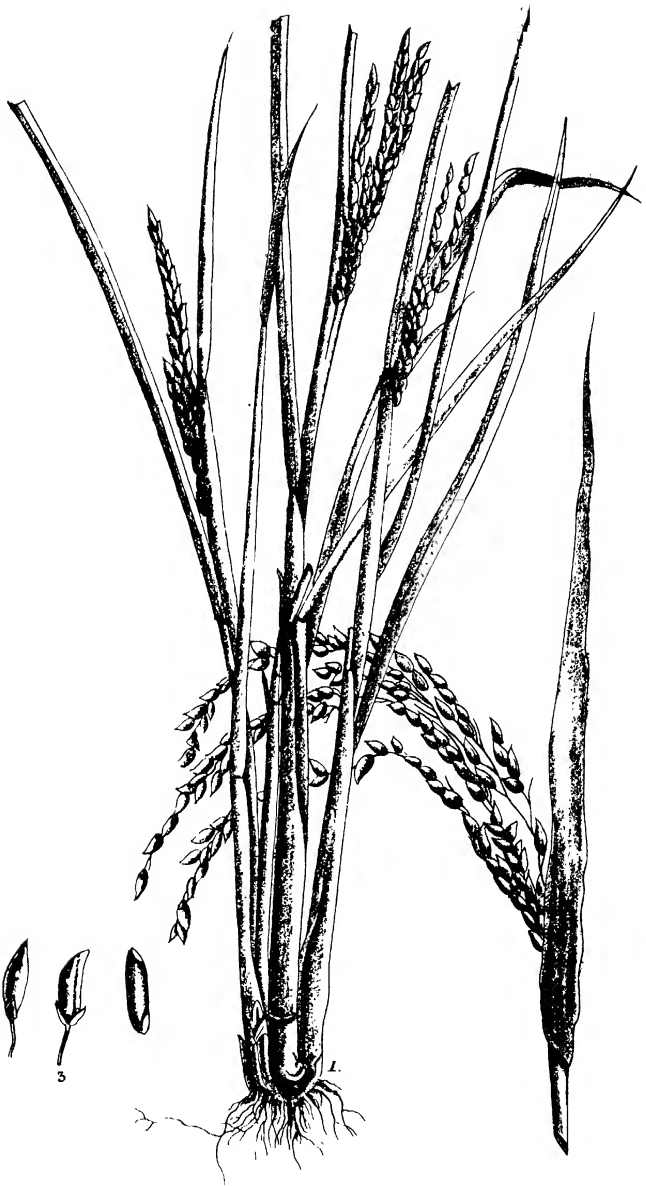
*HEMARTHRIA COMPRESSA.*





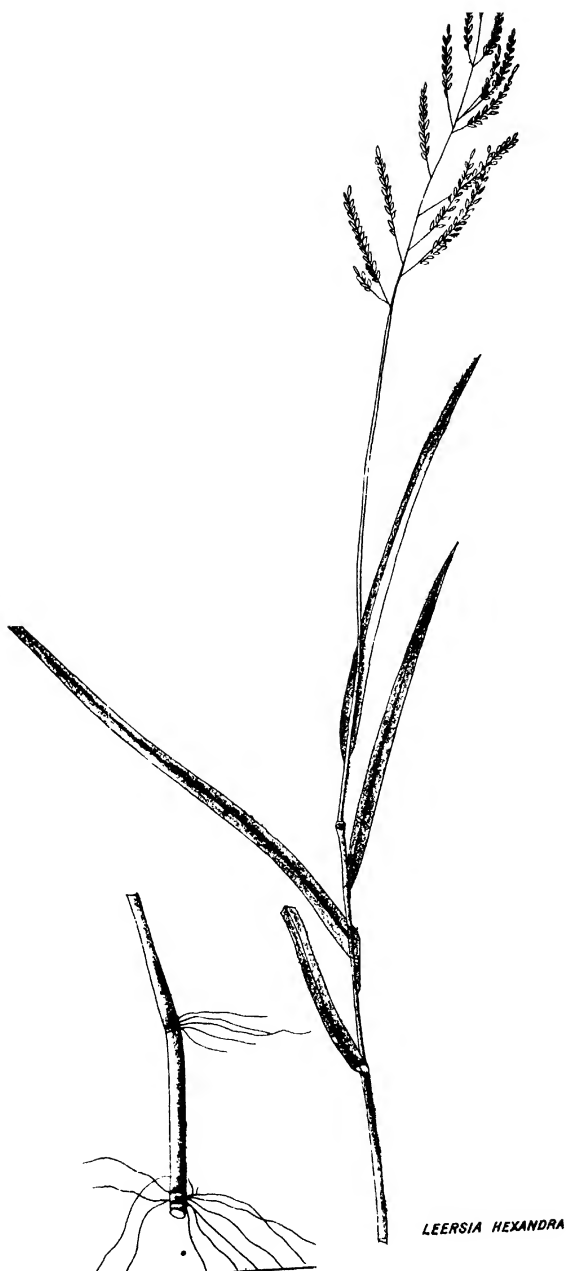
*MANISURIS GRANULARIS.*





*ORYZA SATIVA.*





*LEERSIA HEXANDRA*

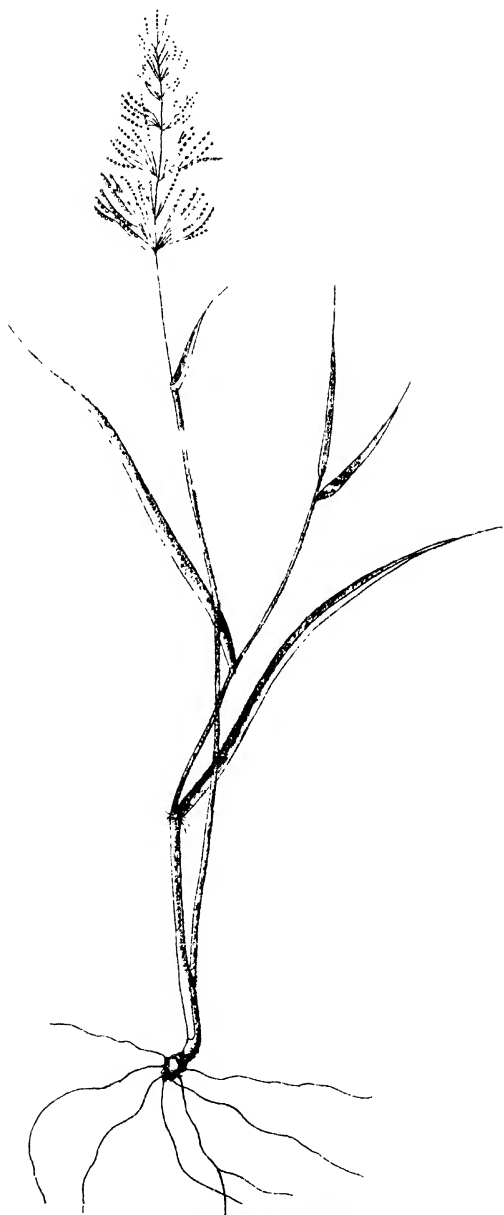






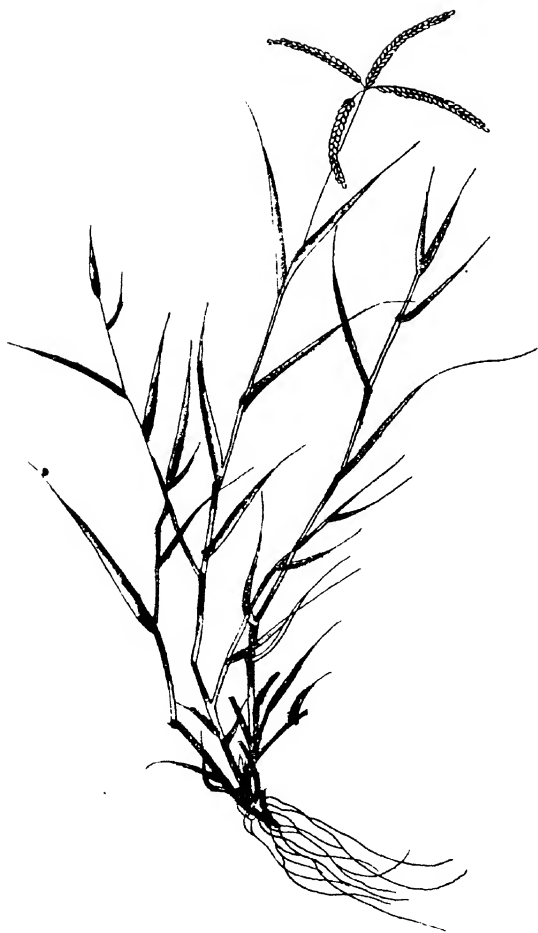
*AGROSTIS DIANDRA*





*AGROSTIS COROMANDELIANA*

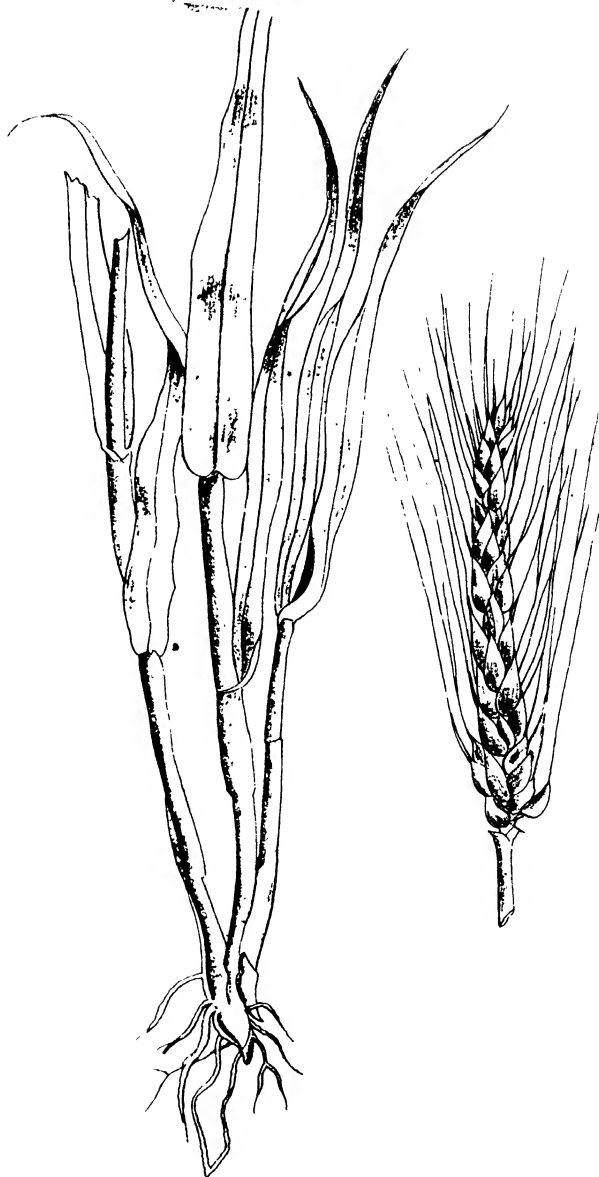




***AGROSTIS TENACISSIMA.***



ADRA8



*HORDEUM VULGARE*





PLATE 60.



*TRITICUM SATIVUM.*





*AVENA FATUA*





*AVENA SATIVA*





*ZEA MAYS.*







17 AUG 1940  
MADRAS

*ARISTIDA DEPRESSA.*





*ARISTIDA SETACEA.*







